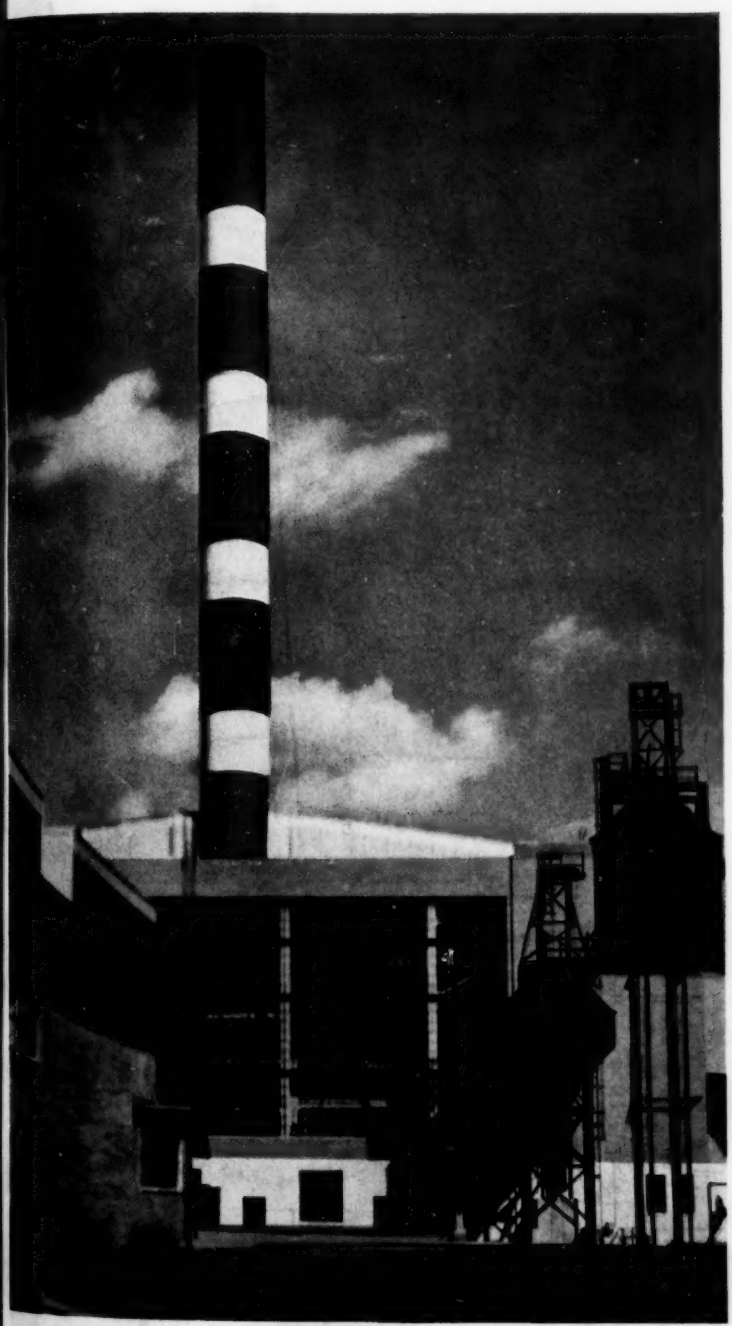
Power Plant ENGINEERING



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COVER: ALTERNATELY RED AND WHITE STRIPED STACK AT TERNSTED TRENTON DIVISION POWER HOUSE OF GENERAL MOTORS FORMS 250 FT LANDMARK FOR FLIERS AT NEIGHBORING AIRPORT.

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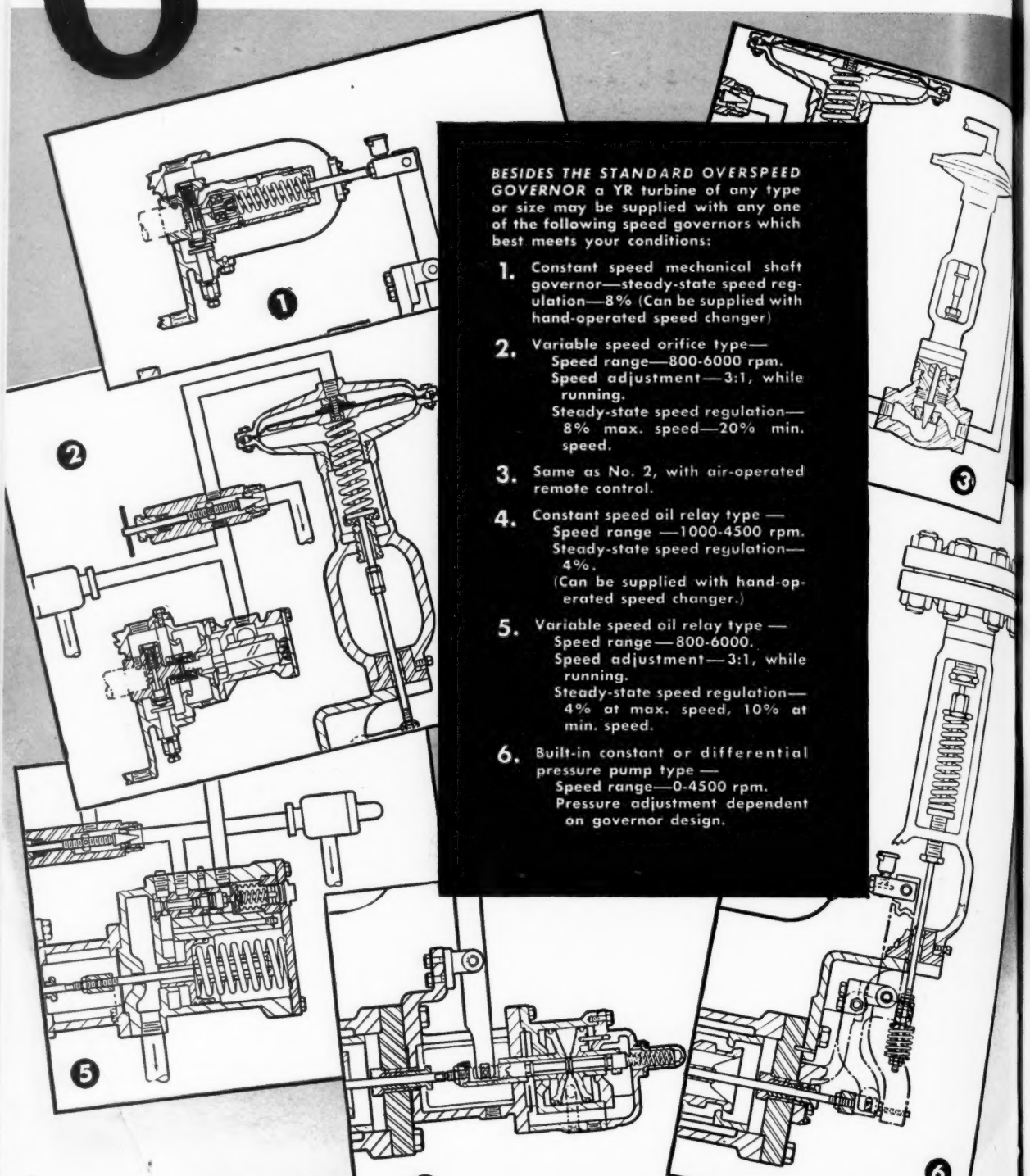
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

OCTOBER, 1947

6 ELECTIVE GOVERNORS *offered*



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Power Plant ENGINEERING

October, 1947

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Jenkins PRACTICAL PIPING LAYOUTS 25

How to plan a SURFACE CONDENSER WITH TWO STAGE STEAM JET AIR EJECTOR

On prime mover exhausts, efficiency demands a high vacuum through condensation. This layout illustrates a typical condenser used with high pressure steam prime mover. The cooling water is pumped through the tubes around which the steam passes and condenses. The condensate can then be re-used after being heated.

Non-condensable gases and air must be removed to maintain vacuum. In this two stage steam jet air ejector, the first stage partially compresses air from the main condenser, and discharges mixed air and steam into an inter condenser where the steam is further condensed and trapped back to the main condenser hot well. The air is drawn off by the second stage ejector and compressed to atmospheric pressure. This mixture of steam and air is passed through an after condenser where the steam is again condensed and trapped back to the main condenser hot well. The air which is at atmospheric pressure is removed from the system through an air vent or air meter.

Each stage of the air ejector is provided in duplicate to assure a full load standby at all times. Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 25, enlarged, with additional information, will be furnished on request. Mail coupon.

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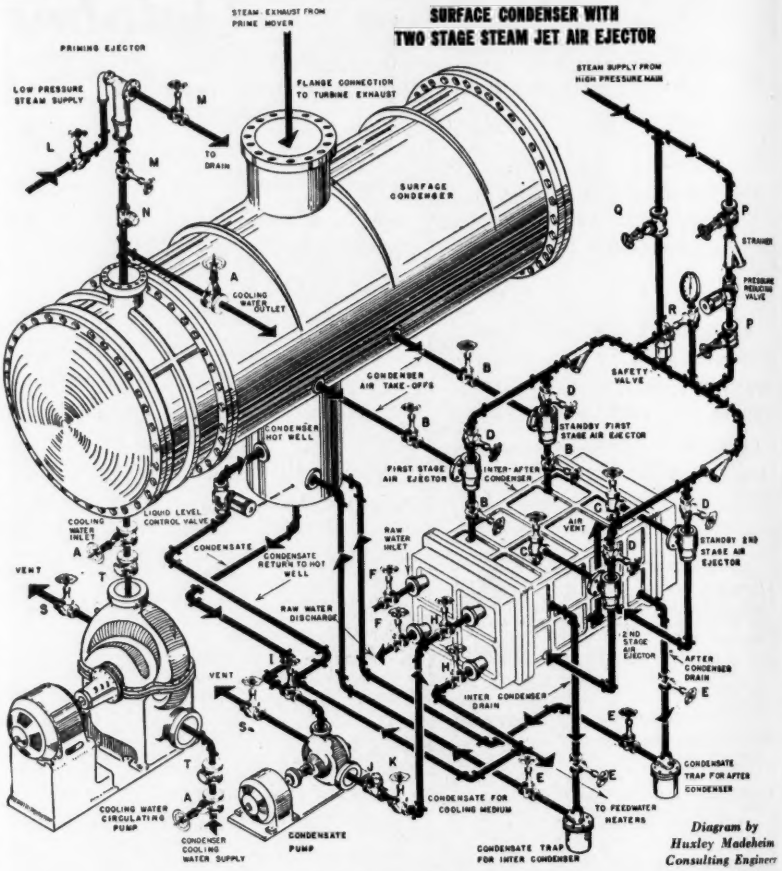

Diagram by Huxley Madeheim Consulting Engineer

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	3	Fig. 651 I.B.B.M. Gate	Condenser Cooling Water Shutoff and Supply
B	4	Fig. 370 Br. Gate	Condenser Air Takeoffs Ejector Selector
C	2	Fig. 108-A Br. Angle	Inter Condenser Air Takeoffs Ejector Selector
D	4	Fig. 976 Br. Globe	Ejector Steam Connections
E	4	Fig. 370 Br. Gate	Inter-After Condenser Condensate Traps
F	2	Fig. 370 Br. Gate	Raw Water Connections to Inter-After Condenser
H	2	Fig. 370 Br. Gate	Circulating Water for Inter Condenser
I	1	Fig. 370 Br. Gate	Condensate Pump Shutdown
J	1	Fig. 92 Br. Swing Check	Prevent Back Flow through Pump
K	1	Fig. 106-A Br. Globe	Condensate Pump Control & Shutoff
L	1	Fig. 106-A Br. Globe	Steam Supply to Priming Ejector
M	2	Fig. 370 Br. Gate	Priming Ejector Shutdown
N	1	Fig. 92 Br. Swing Check	Prevent Back Flow to Condenser
P	2	Fig. 1012 Cast Steel Gate	Pressure Reducing Valve Shutoff
Q	1	Fig. 1046 Cast Steel Globe	Manual Pressure Control
R	1	Fig. 970 Br. Globe	Control Pressure Gauge
S	2	Fig. 106-A Br. Globe	Vents for Pump
T	2	Fig. 295 I.B.Swing Check	Cooling Water Pump

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ENGINEERS' PREVIEW

PORTABILITY is featured in Homelite fast, completely-automatic self-priming pumps—one man can pick it up, carry it where needed. High suction lift, 28 ft permits pumping deep pits or wells. Non-clogging, non-scouring design with replaceable wearplates allows handling mud and solids; discharge pressures to 40 lb, heads to 100 ft, make it suitable for auxiliary fire protection, fire engine booster tanks, water supply to outlying operating points, to tank wagons, concrete mixers, etc. Available in 1½, 2 and 3 in. sizes with built-in gasoline engines, 4,000-15,000 gph capacities. Electrically-driven 2 and 3-in. units, available on special order, also mobile 4-in., 30,000 gph unit.

★ ★ ★

TO ELIMINATE rocking and vibration, Equi-Balanced patented crankshaft mechanism combines equally-spaced and reciprocating forces, balances them, giving the better features of both in-line and V-types. In the two-throw shaft for air compressors, throws are spaced at an angle supplement to that of the V, spreading the working strokes evenly over 360 deg. Used in new 60 and 105 ofm V-type compressors.

★ ★ ★

ROSITE, an inorganic plastic (calcium aluminosilicate reinforced with asbestos fibers) has the physical characteristics of a stone-like material, is unaffected by oil, alkali, sunlight, has a compressive strength of 15,000 psi, modulus of rupture of 7500 psi, can be molded to intricate shapes with close tolerances. Usable for fuse blocks, circuit-breaker housings, switchboard panels, terminal blocks, many others. Has a softening point about 2000 deg F. Has dielectric breakdown of 50-80 v a mil, favorable arc-resistance equalities, is resistant to 900 deg F has 50,700 megohms surface resistivity per unit area.

★ ★ ★

DESIGNED for very high temperature or pressure service, process centrifugal pumps, 40 to 1500 gpm at 1750 to 4000 rpm, handle hot or cold liquids near boiling point, insure continuous operation, have broad capacity range, no stuffing boxes, can handle extremely high suction pressure or vacuum. Allowable operating pressure for cast iron 600 psi at 100 F to 500 psi at 450 deg; for steel, 1000 psi at 100 F to 500 psi at 800 F.

★ ★ ★

INDUSTRIAL LUBRICATING cart is a complete service on semi-pneumatic tires, carries a supply of two greases and one oil, needs no air nor electric connections. This one-man portable unit maneuvers easily between units, is said to speed production. Two No. 1 lever guns, one ½-pint pistol oiler, are included, pump has built-in gun-loader for hand guns. Compartments are easily filled without removing pumps. The front hinged section encloses a large tool box, its top serves as a step platform for high bearings.

RADIO-ACTIVE tracers spotted weaknesses in cement casing of oil wells and speeded completion of some wells as much as 40 days, by preventing formation of mud channels in the cement; also reduced operating time and costs. This newly-discovered process is finding use in Venezuela multi-zone where two or more separate reservoirs are produced independently through one well.

★ ★ ★

FOR water, all kinds and qualities, other liquids, semi-liquids in production or laboratory work, a direct-reading pH meter has assembly of glass and calomel electrodes, and resistance thermometer to provide automatic temperature compensation from 0 to 100 deg C. Glass electrode is convertible bulb type. Special galvanometer-movement design insures high degree of sensitivity (accurate to 0.1 pH), stability and freedom from mechanical vibration or interference in 7 by 8½ by 11¼ metal case, weight 10 lb, operates on any 110 v a-c 50 or 60 cycle current, range is from 0 to 14 pH.

★ ★ ★

ELECTRIC PANEL HEATING uses conductive-rubber ceilings, each panel containing 4 sq ft of it between thin plastic layers. Electricity is conducted to edge of panel by copper wire; no wires inside heating area. Ceilings can be papered or painted. Space above ceiling is insulated with 8-in. rock wool. Estimated that small house can be heated for $72 a year at TVA or equal rate, if well insulated. Experimental house at Knoxville, Tenn., used 1960 kwhr in 24 days of March, 1947.

★ ★ ★

PORTABLE a-c voltage regulator for electronic control circuits features a load range of 10 to 100 per cent, frequency 50 to 60 cycles, power factor 70 per cent lagging to 90 per cent leading. For light loads Model 150 has an input voltage range of 95-125 with 115 v output. Maximum recovery time 6 cycles. Size 9 by 7½ by 6 in. Accuracy of regulation ½ per cent, maximum harmonic distortion 5 per cent.

★ ★ ★

TO PROTECT the finish on painted machinery and equipment, floors, walls, all coated surfaces, apply a new water-thin crystal-clear liquid impervious to heat, cold, moisture, caustic soaps, alcohol, alkalies, most chemicals. Put on clean surfaces with a cloth, it becomes "touch" dry in 10 minutes, "hard" dry in 6 hours. A damp cloth keeps surfaces clean after application.

★ ★ ★

METAL SCAFFOLDING base 12 by 84 in., weighs 34 lb, sustains more than 1000 lb safely, has non-skid stamped raised-grid surface. Hooks on each end for ladder rungs or scaffold supports. For maintenance men, carpenters, painters, paperhangers, interior decorators, etc.

DEHYDRATED in manufacture and ground to an impalpable powder, Thermo-Lo-Blue welding flux does not stick to the welding rod nor lift off the work when temperature rises, produces strength, machinability, nonporous welds, also is reported to make low-temperature welding possible through its fineness.

★ ★ ★

BY USE OF an hydraulic motor and gear reduction to rotate the truck's entire fork assembly, boxes filled with scrap, paper rolls, barrels, other odd-shaped loads can be unloaded directly with no intermediate handling. Mechanism is adaptable to a shop truck, to fixed or adjustable forks, scoop or other special attachments.

★ ★ ★

NEW WN-200 self-powered arc welder, designed for shop, yard or field, may be had as portable or stationary unit. Rates at 200 amps 30 v at 2900 rpm with 30-260 amps welding range. Four cylinder air-cooled 26.5 hp engine and five-strand V-belt drive. May be carried on running gear of standard track width. Portable has two rubber-tired wheels, auto hood, drawbar with locking chains.

★ ★ ★

SPRINKLER PIPE installations are expensive, often requiring extensive wall damage in chipping out large areas for beam clamps. New low-cost stud-welding accepted by Underwriters Laboratories, reduces such hanger work, costs and redecoration to a minimum. A hole just large enough for insertion of a Nelson stud and ferrule is the only drilling or chipping required, the hanger being screwed into this threaded ferrule from below.

★ ★ ★

MOTORIZED 3-ton truck designed to simplify the reeling, unreeling and horizontal movement of cable spools, will handle them from 3 to 7 ft in diameter and up to 33-in. widths (specials for greater widths) or any parallel units or work. Built on a standard Transporter drive reel-handling mechanism consists of adjustable hooks for various sizes and mountings, and locking gear racks in which reel axle rests, and hinged trailing axle which lifts load from the ground when drawn forward by truck's electric lift. In cable work reel is wound or unwound by turning reel or by fastening cable and moving truck toward or away from it.

★ ★ ★

TINY BLOWTORCH uses dry chemical fuel in tablets, a wholly-new principle that eliminates spilling, evaporating or explosion. Weigh a few ounces, is held between thumb and finger, always ready for use, needs no preheating, equipped with brass cup to hold tablets, brass tube supporting cup and adjustable clip. Air-cooled handle is nickel-plated steel, mouth tube clear, sanitary, flexible plastic, only gentle blowing is necessary. Super-Fuel tablets burn 10 minutes, giving intense heat, doing clean work without residue. Temperatures above 2000 deg F are produced. Super Jet blowtorch is suitable for soft or silver soldering, light brazing, annealing or hardening small work.

★ ★ ★

FLASH-O-TEST, new double-purpose tester and flashlight, enables making simple, rapid continuity checks; when not so used it may be utilized as a flashlight in other electrical testing.

DEVELOPING 400 cycles, compact high frequency unit consists of 14-pole, 3440 rpm, 1000 v a generator and 4-pole d-c motor, with both armatures on one shaft, has 10 per cent voltage regulation with 60 per cent power factor load and 7 per cent regulation with unity load; overall efficiency 50 per cent. Unit is 13⅜ high, 12⅜ wide, 23 11/16 long, weighs 210 lb.

★ ★ ★

NO LARGER THAN a man's hand, Model 390 electrical measuring instrument will give voltage, amperage and wattage readings on any appliance with a motor or heating element, will serve industrial installations. Has break-in plug with four color-coded leads. These are attached to instrument, plug placed in outlet and appliance of unit to be tested plugged into it. Meter ranges: watts 0-300, 0-600, 0-1500, 0-3000; v 0-150, 0-300; amps 0-3, 0-15.

★ ★ ★

NEW VARIABLE SPEED transmission has hand screw control for setting output shaft speed, hydraulic servo-motor lever control for instantaneous and stepless variation of shaft speed in either direction, hydraulic two-speed control and electrical three-position remote control. Input speed is 1750 rpm, output variable up to 1600 rpm, starting torque 125 in-lb normal continuous torque 90 in-lb. Suitable for a wide range of machines and drives.

★ ★ ★

CENTRIFUGAL TYPE tachometer with electronic control can be used as a control or safety device. Stray currents have no effect, nor extreme temperatures. Operates on very tiny current amplified more than 1000 times to energize relay. Red indicator hand is set to control maximum speed; when this is reached, device actuates relay that will shut off equipment, ring a bell, flash a light or other operation as required. Can be supplied with dial in any desired markings. Has circular face with rotating hand like a watch; separate control is in a small neat rectangular container.

★ ★ ★

PRODUCTION-LINE method of multiple stations is embodied in new hydraulic press for compression molding of ceramics, this two-rod down-moving unit being equipped with a four-station manually-operated dial feed to facilitate loading and unloading. While one mold is being pressed, another is filled at loading station, a previously-pressed mold is removed at unloading station thus using several operators to speed output. Hand lever control has three positions, down, neutral, up. On up stroke slide ascends at a faster speed. Pressure is adjustable and uniform thruout the 14-in. stroke. On oil cooler maintains the most suitable temperature. Two standard sizes, 75 and 150 tons, floor space 74-91 in. overall height 9½ ft.

★ ★ ★

COLD-ZONE TESTER for refrigerating equipment temperature checking has a range from —50 to plus 50 F. Temperature element has a 14-ft polyethylene lead to connect with indicating instrument, and this lead thin enough not to interfere with weatherstripping remains flexible at —50.

XUM

XUM

HELPFUL BULLETINS

BOILERS, BURNERS

1 **Heating Boiler**—Catalog 88-4 is a 4-page bulletin describing this company's Type R boiler designed for heating medium sized buildings. Illustrations of the unit are presented and several tables of dimensional drawings are given. A line drawing accompanies this table to indicate various dimensions. Kewanee Boiler Corp.

2 **Oil Burner**—This new bulletin describes the company's new wide range Y-Jet Steam Atomizing Oil Burner. It covers the construction, application and advantages of the unit and shows how it has established an excellent standard of performance in both marine and stationary plants. Burners now installed, the bulletin points out, are operating at capacities ranging up to 6000 lb of oil per hour. Babcock & Wilcox Co.

3 **Heavy Oil Burner**—Form 4701 describes a new heavy oil burner designed for industrial application. The bulletin points out that the burner utilizes No. 5 or 6 fuel oil and then goes on to explain the reasons for the burner's high rate of efficiency. Detailed parts of the unit, such as the oil volumeter, dual pump and reservoir, the flame shaper and the single control lever are described and the bulletin points out how they account for superior performance of the unit. There are 4 pages in the bulletin and it is printed in 4 colors. Iron Fireman Mfg. Co.

FUELS

4 **Spreader Stokers**—There are 8 pages in this bulletin on the Firite spreader-type stoker. Illustrations of actual installations and line drawings of complete unit and auxiliaries introduce the subject on the opening pages. Various designs for power dumping, manual dumping or stationary grates are discussed on following pages. These pages are well illustrated. Information on details of construction and sizes and capacities follow. Hoffman Combustion Engineering Co.

5 **Magnetic Separation**—Catalog 770 is a 28-page booklet which describes a line of magnetic separators for use with super-high intensity induction machines and cross-belt type separators. Tables of relative magnetic attractive force of various minerals accompanies the descriptions of the types of machines. The super-high intensity Type IR Induction Magnetic Separator is described in detail—a general description, including an excellent drawing, is followed by details of the operation and adjustment of the unit and a complete story on the design of the equipment. Capacity and power consumption and a diagrammatic drawing of the sizing of materials follows. Typical installations and tables of capacities are presented. Dings Magnetic Separator Co.

6 **Magnetic Pulley**—The company's non-electric permanent magnetic pulley is described in this 8-page bulletin 501A. The advantages of the unit are described and illustrations show some of the reasons for use when fire hazards are present and when maintenance costs must be kept low. Photographs show installations in various industries and a full-page chart of material factors for determining pulley size is given. On this page are two worked-out examples for determining pulley size under two different sets of conditions. Another useful table is one of capacities, dimension and weights. Eriez Manufacturing Co.

7 **Materials Dewaterizer**—Bulletin 129 describes and illustrates a new method of dewatering coal and other material by means of the company's new Hiptex Dewaterizer. This 4-page bulletin gives case histories which demonstrate the ability of this method to remove surface moisture from coal and other materials in sizes as small as ⅛ by 0 in. according to the company's release. On these smallest sizes the dewaterizer leaves as little as 12 per cent surface moisture; on larger sizes, as little as 4 per cent. Robins Conveyors Div., Hewitt-Robins, Inc.

ELECTRICAL

8 **Fuse Booklet**—An excellently done 16-page pocket-sized booklet on the outstanding features of construction of this fuse (such as the renewable link and spring tension locking of links in circuit) was issued recently. Easily-understandable full-page wash drawings are used to emphasize every feature discussed. Two pages of prices and specifications on the fuses are given in the back of the book. Ware Brothers.

9 **Automatic Synchronizers**—Bulletin SN-400, describes the application of this type SN model SF automatic synchronizer, which is designed to automatically control circuit breaker closure of a-c generators in paralleling to a common bus. Descriptions of the operation and application of the unit are accompanied by circuit diagrams and curves illustrating the proper and improper conditions for synchronizing. Installation and maintenance instructions and special applications also are illustrated. Burlington Instrument Co.

10 **Motors**—Motors for Machine Tools is the subject of Bulletin MU-25A, an 8-page booklet. A brief outline of the characteristics necessary in a motor designed for this type of service is followed by a complete description of how the company meets these demands in its particular unit. Examples of how the motor is serving industry in many applications are portrayed by means of photographs of applications. Wagner Electric Corp.

11 **Communication Problems**—"How to Solve Communication Problems" is the title of Form 235, an 8-page bulletin which was issued recently. The booklet shows how this electronic inter-com handles intra-plant communications and does away with switchboard bottlenecks and costly telephone call backs. A complete description of the unit and various typical installations are described and pictured. A description of the company's sales and service also is given. Executone, Inc.

12 **Voltage Control**—Bulletin 547 is a 12-page booklet covering voltage and control instruments, variable transformers, powerstats and voltage regulators. Performance data of the various units are shown in charts and construction details are indicated by accompanying line drawings. Detailed descriptions of all the units are given. One full page of connection arrangements is presented and a full-page table of ratings, in tabular form, are published. The Superior Electric Co.

13 **Motors, Generators**—This catalog is issued by a Swiss concern, is printed in Swiss, and illustrates many of the various types of generators and motors produced and installed by this company. Brief descriptions of the various pictured units accompany the illustrations. The booklet contains 8 pages. Secheron, Geneva, Switzerland.

14 **Paging Service**—"The Great Time Saver," is the title of a new 12-page brochure which describes the company's line of equipment for paging service. Action photographs taken under representative business conditions take up almost the entire booklet to demonstrate how this paging service locates key personnel. Locating the watchman for after-hours deliveries, or when a police patrolman discovers something that needs immediate attention or other services illustrated. The Autocall Co.

15 **Communications Equipment Booklet** To provide designers of communication and electronic equipment with a quick list of products available for their use, a new booklet covering parts and materials for radio transmitters, radio receivers, radar, telephone apparatus, electronic heating sets and electronic control is the purpose of Bulletin B-3610. Typical of the products described and illustrated in the booklet are circuit breakers, electronic tubes, instruments, transformers, rectifiers, switches and relays, dynamotors, etc. Application data, performance curves, etc are given. Westinghouse Electric Corp.

METERS, CONTROLS

16 **Flowrator**—Catalog Section 25-E is a 24-page booklet describing the Series 700 Flowrator. The design and the construction of the unit occupy the first 3 pages of the bulletin and details of the unit's construction follow. Panel mounting of the units for various applications are shown and applications under varying conditions with consequent modifications, are described in detail. Accessory equipment, such as intregal control valves and capacity markers are also covered. Use of the equipment in connection with flow alarms and installation suggestions are covered. Fischer and Porter Co.

17 **Liquid Level Indicators**—Bulletin WG-1822 is a 16-page booklet describing liquid level indicators for boilers, heaters, storage tanks and other vessels in power and industrial process plants. The bulletin describes outstanding features of the indicators and presents excellent line drawings, in color, of the unit. Construction and operating details of various parts are listed. Installation of the units is covered by several pages of descriptive material which are accompanied by excellent line drawings. Further information includes instructions on how to specify the indicator and photographs of typical installations. Yarnall-Waring Company.

18 **Control Equipment**—This 100-page catalog, No. 47, embodies much of this company's original engineering thinking which in turn was based on the most recently developed needs of the process industries. The equipment illustrated according to the company, capitalizes fully on the production methods and several of the units shown are said to represent the greatest advances in equipment. This new catalog is made up of 5 sections

OCTOBER

POWER PLANT ENGINEERING

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covering diaphragm valves, liquid level controllers, strainers, pressure reducing and regulating valves, pump governors and much steam plant equipment. The booklet is exceptionally well illustrated with over 250 cutaway views, performance charts and tables. The book is ring bound. Kieley & Mueller, Inc.

19 **Area Meters**—Bulletin 233 describes a recently-announced area meter; the bulletin contains 4 pages. Details of the unit's construction are pointed out in a sectional view and the accompanying information covers the receiver, transmitter, principles of operation, power requirements, etc. Bailey Meter Co.

20 **Level Control**—Bulletin F2406 describes a dual-pilot Level-Trol announced recently by this company. The booklet contains 8-pages and presents information on applications, adaptability and performance of the unit. Detailed descriptions of controls, visual indicator scale, the controlling pilot, indicator mechanism and performance are given. Illustrations show various views of the unit and 3 charts present test results. Fisher Governor Co.

21 **Steam Control System**—An instruction manual on this company's "All Vac" steam control system has been issued recently; it contains 30 pages. The booklet first presents primary information on heat and vacuum pressure and illustrates this part with simple, easily understood line drawings. Following this preliminary section an introduction to the All Vac steam control system is presented. A full-page drawing presents a schematic diagram of the system. Other large drawings illustrate the mechanical operation of the differential control valve and what happens when heat is unbalanced. Instructions on "How to start the All Vac system" are given. All Vac Steam Control System, Inc.

22 **Surface Pyrometer**—Catalog 160, 4 pages, describes a surface pyrometer designed especially for innumerable production and laboratory requirements for a quick and accurate method of determining surface and sub-surface temperatures. Outstanding features of the unit are described in detail and photographs illustrate models and parts. Detailed descriptions of types and parts and applications of them are given. The Pyrometer Instrument Co.

HEATERS, COOLERS

23 **Open Heaters**—Publ. 4091 is a 24-page bulletin that has just been issued; it covers three lines of open heaters for direct contact heating of boiler feed and industrial process waters with available exhaust or live steam. The bulletin describes the characteristics of the various heater designs, accessories and gives actual installation photographs and flow diagrams with which are supplied supplementary data. Cochrane Corp.

24 **Water Coolers**—Freon water coolers are described in a recently-issued 12-page bulletin. The bulletin tells about the standard construction specifications of such parts as the tube sheet. Freon chamber, tubes, shell, supports, baffles, etc. Line diagrams and photographs bring out many of the points discussed. Instructions for Selecting also contains useful diagrams. A worked-out example of how to select a water cooler for certain conditions renders this section all the more useful. Other important data are suction and liquid line sizes, direct leading log, mean temperature difference table, etc. The Paterson-Kelley Co., Inc.

GASKETS

25 **Gaskets**—Catalog 47 is a 64-page, spiral-bound, general catalog of this company's line of gaskets, sheet packing, washers and metal stampings. The bulletin first conducts the reader through the entire manufacturing process. Next it presents a standard gasket selector on which the various types of gaskets are illustrated; this section is of assistance in fitting the right material to the right job. Tables give sizing information on gaskets. A large part of the booklet is given over to engineering data which consist of tables of circumferences and areas of circles, Centigrade and Fahrenheit conversion tables, decimal equivalents, steam tables, comparative properties of synthetic rubbers compared with natural rubbers. Melrath Supply & Gasket Co., Inc.

PUMPS, COMPRESSORS

26 **Jet Compressors**—Bulletin 4F is a new 12-page catalog covering jet compressors together with a section of their construction and operation. Tables and drawings give complete information on dimensions, connection sizes and weights of the different types. Colored diagrams with detailed explanations describe typical applications of jet compressors in numerous industries such as paper making, vulcanizing, various chemical industries and gas plants. Schutte and Koerting Co.

27 **Small Centrifugal Pumps**—Bulletin B-165 is a recently-issued 8-page booklet which describes two types of general utility centrifugal pumps with power drives from fractional to 20 hp. The bulletin shows how the pump may be installed in any position and it also stresses the ease of maintenance and accessibility of the unit. The bulletin is well illustrated and presents many useful tables of data. Peerless Pump Div., Food Machinery Corp.

TOOLS, HARDWARE

28 **Tools Catalog**—Wrenches, pipe cutters, tubing cutters, pipe vises, vises, saw vises and other tools are described in this 16-page catalog. Each of the tools is described in detail and tables of sizes and prices are included. Other price lists are given for tool parts. The booklet is bound in a heavy paper cover. Trimount Mfg. Co.

29 **Pliers, Wrenches**—Bulletin 4728 is a recently-issued 4-page bulletin which describes and pictures a complete line of pliers and adustable wrenches and a line of pipe wrenches. Complete specifications of all the tools are listed. Plomb Tool Co.

30 **All-Purpose Electric Tool**—This company's recently announced all-purpose electric impact tool is described in this 4-page folder. The bulletin points out that the tool, using standard attachments, will apply and remove nuts, drill, ream, tap, drive and remove screws, drive and remove studs, extract broken cap screws and studs, run wire brushes, do hole saw work, drill brick and masonry and drive wood augers. The bulletin shows the machine in operation on many types of jobs and thoroughly describes its operation and construction. Ingersoll-Rand.

31 **Industrial Hardware**—Catalog No. 140, 32-pages, contains engineering information on this company's line of wire rope and chain fittings. In addition to presenting detailed working characteristics of each product the company has included tables and charts which make the catalog a valuable reference book. Many new products are described in the bulletin. The Thomas Laughlin Company.

WELDING, CUTTING

32 **Welding and Cutting Equipment**—Form 20A is a 20-page bulletin illustrated completely in four-color natural photographs and it covers the company's line of industrial cutting and welding apparatus. Complete descriptions of the equipment are given and prices of all items are clearly indicated. Special construction features are explained and operating ranges are given. Victor Equipment Co.

33 **Arc Welding Accessories**—Bulletin 120, "Arc Welding Accessories," contains 16 pages. Among the types of equipment covered in the bulletin are cable connectors, cable lugs, cable splicers, cleaning tools, cover plates,, eye shields, ground clamps and many others. Tables of sizes and capacities are presented wherever they apply and the booklet is well illustrated. Metal & Thermit Corp.

34 **Welding Electrodes**—Resistance welding electrodes and alloys are covered in Bulletin 68B and a separate price list is provided. This new publication, 24 pages, catalogs a comprehensive line of spot welder tips and holders, seam welder wheels and other resistance welding accessories. The bulletin is profusely illustrated with diagrams showing dimensions of tips and holders. It contains tables of properties of alloys grouped by RWMA classifications, applications, stock sizes, etc. Ampco Metal, Inc.

MAINTENANCE

35 **Maintenance Products**—"Products for Maintenance and New Construction" is the title of a new 20-page bulletin. The booklet first describes the properties of pitch and asphalt products and continues with a description of types of built-up roofs which use pitch, felt and asphalt and then goes on to further cover roof maintenance products. A more detailed description of the material and its properties is presented in the back part of the bulletin. It is well illustrated with both photographs and sketches. It is bound in a heavy enameled cover. Union Chemical & Oil Co.

36 **Waterproofing Q & A**—This bulletin is devoted chiefly to a Questions and Answers section on the use of Aquella for the control of water seepage and dampness. The first pages in the bulletin tell what the material is and how it works; pictures are presented which show how the material withstands hydrostatic pressure and also shows an unusual waterproofing problem and how it was solved. The Questions and Answers section follows. Prima Products, Inc.

37 **Rubber Base Enamel**—The use of this rubber base enamel in industry is described in this new folder. The bulletin tells how the enamel resists acids, free alkalis, water and other chemicals and shows how it is an excellent paint for use in dairies, food processing plants, sewage disposal plants and other industrial locations. Samples of the colors in which the enamel is available are attached to the bulletin. American-Marietta Co.

38 **Corrosion Resistant Equipment**—Bulletin K, 16 pages, describes a line of corrosion-resistant material and equipment. The bulletin material to aid the engineer in selecting proper or suitable corrosion-resistant materials and to help them in determining quickly how these materials may best be used for combating corrosion. Materials described include ceramics, duralon, lead and others while the equipment includes tubing, lining materials, protective coatings, mixing equipment and masonry. The bulletin is exceptionally well illustrated and a table of application and qualities of protective coatings is presented. U. S. Stoneware Co.

VALVES, TRAPS

39 **Tri-Filter Valve**—This 4-page bulletin No. 108, describes a tri-filter valve which is said to be capable of doing the

(Continued on page 180)

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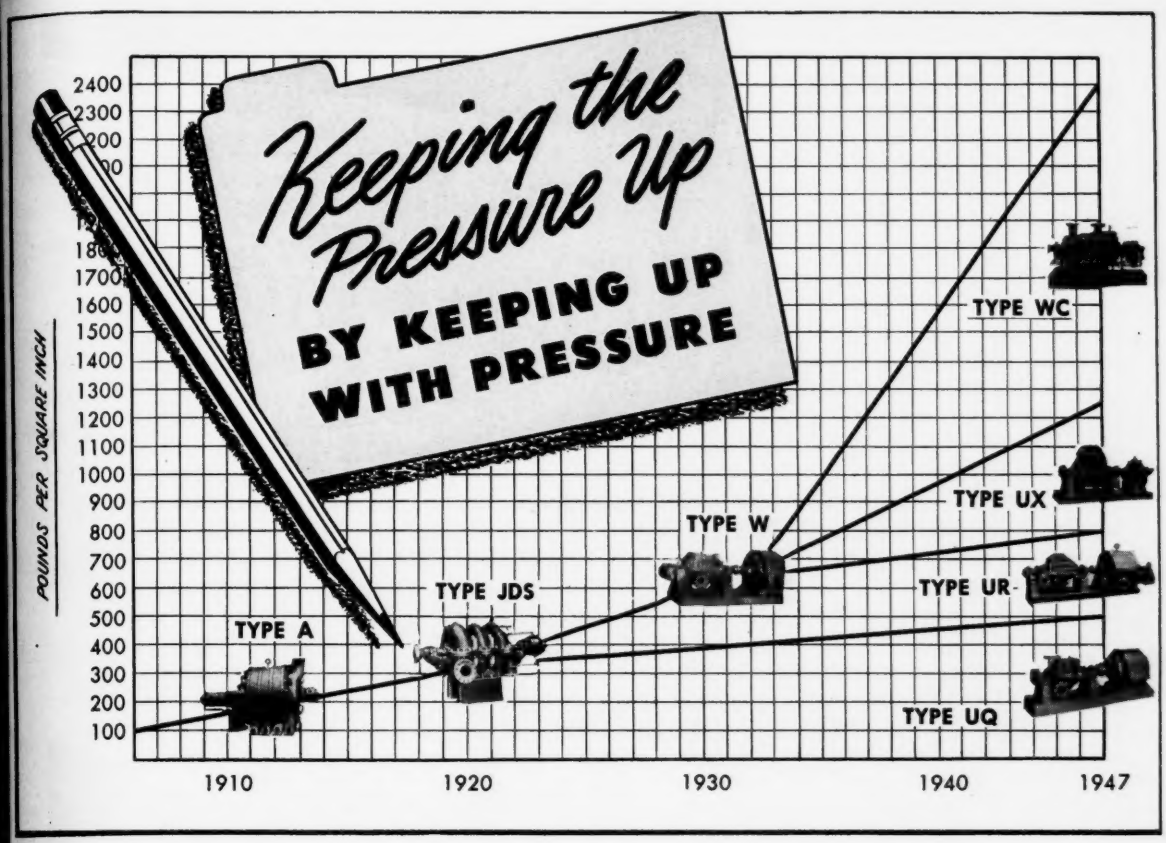

The graph shows you how closely Worthington has kept pace with industry's demands through the years . . . by developing centrifugal pumps to handle steadily mounting boiler feed pressures.

It's a record of steady progress . . . from the old Type A, a great performer at 200 psi . . . to the powerful modern Types WC, UX, UR and UQ, with pressures ranging from 2½ to 12 times the 1910 "ceiling".

THE LONGEST AND BROADEST EXPERIENCE

In addition, out of Worthington's more than 100 years of pioneering in pump design and manufacture have come such notable improvements as the Elastic Seal Ring for tight interstage joints in axially split-case pumps . . . the Metal-to-Metal Ring Type Joint in solid-case barrel pumps.

FOR YOUR OWN BOILER FEED REQUIREMENTS

Worthington has the most complete line of centrifugal pumps — all pressures, all capacities — and engineers trained to fit feed pump to feed cycle for maximum economy and dependability.

For details that prove *there's more worth in Worthington*, contact our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

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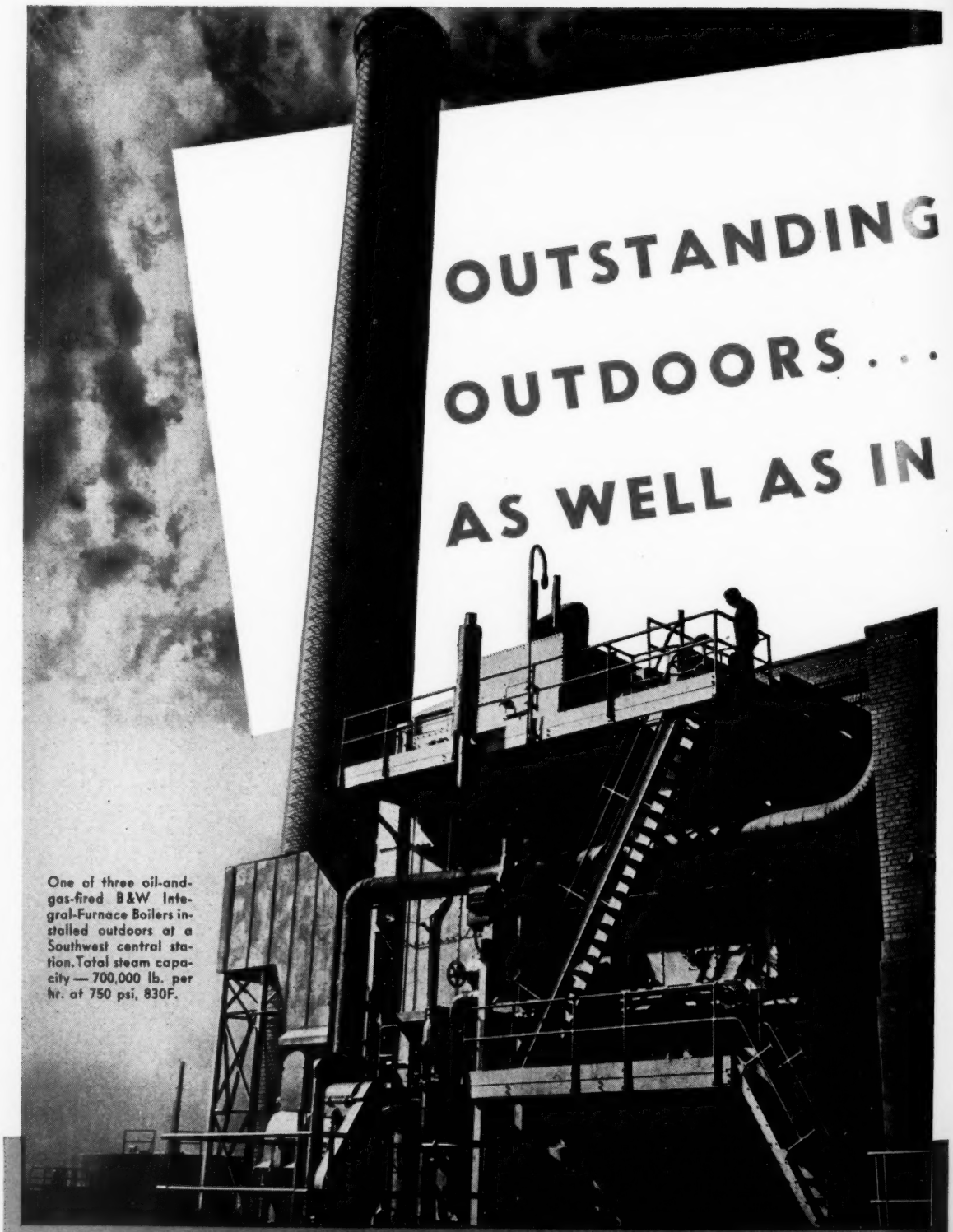
THE WORLD'S LARGEST MANUFACTURER OF PUMPS

For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet



One of three oil-and-gas-fired B&W Integral-Furnace Boilers installed outdoors at a Southwest central station. Total steam capacity — 700,000 lb. per hr. at 750 psi, 830F.

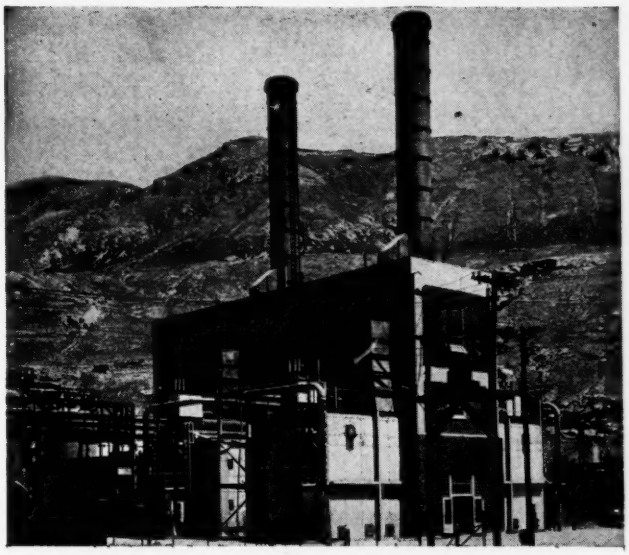
Outdoor and Semi-Outdoor Installations of B&W Boilers:

By Industry: Central Station, Refineries, Chemical Plants, Rubber Factories, Manufacturing Plants.

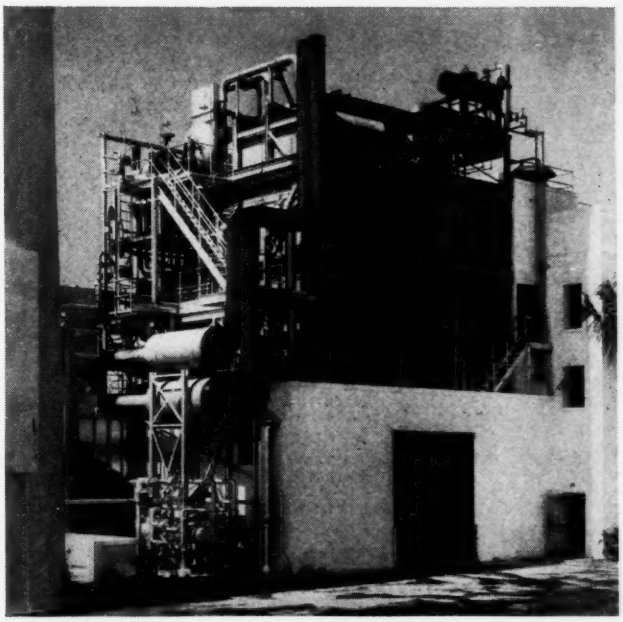
By Locations: Arizona, California, Colorado, Florida, Iowa, Kentucky, Louisiana, New Jersey, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, Texas, Utah, Argentina, Colombia, Cuba, Mexico, Netherland West Indies.

Outdoor and semi-outdoor installations are an old story with B&W Boilers. They have been identified with these types of power plants since their inception over 15 years ago. More than 100 Integral-Furnace, Radiant, and Stirling units with an aggregate steam capacity of 17 million lb. per hr. are now in service or on order. Individual steam capacities range from 25,000 to 500,000 lb. per hr., with pressures up to 1500 psi and temperatures up to 950 F. Fuels include pulverized coal, gas, oil, wood, and industrial refuse.

Installations are located in fifteen different states—North, East, South, and West—and in several countries abroad. Exposed to all kinds of climatic conditions—snow, rain, high winds, temperatures from —30 F to over 100 F—these B&W boiler installations are giving the same high standards of performance and economical operation that have made B&W boilers the leading choice for conventional indoor plants for 80 years.



Four 65,000 lb. per hr. B&W Integral-Furnace Boilers installed outdoors at a Utah refinery. They are fired with oil and gas.



A 200,000 lb. per hr. oil-fired B&W Integral-Furnace Boiler installed outdoors at a new central station in Florida. Unit is designed for future use of pulverized-coal.

0-302 T

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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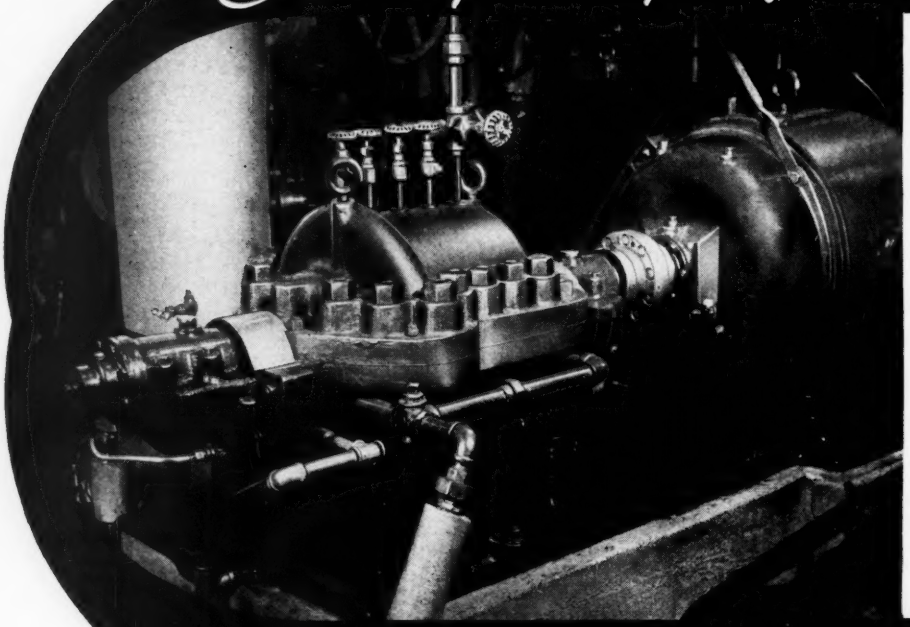
XUM

Hardly a sign of wear...



Can you match this record?

This relatively small boiler feed pump, delivering 250 gpm against 513 psi, required no replacement parts or reconditioning after 45,000 hours of service.

...after 45,000 hours of service

THE EXCELLENCE OF DE LAVAL design and construction is demonstrated by the performance of a De Laval boiler feed pump recently inspected after 45,000 hours of service in the municipal power plant of the City of Wyandotte, Michigan.

The following paragraph is quoted from the inspector's report:

"All machined surfaces of the case are in original condition. Diaphragms and balance arrangement fit neatly in all bores. Horizontal joint has no indication of leakage. Faces of rotating and stationary balance plates are in good condition; wear is approximately .005". Shaft sleeves are highly polished but are not worn or grooved. There is no leakage between shaft sleeve spacers and wheels. The shaft has no indication of contact with water. Wheel wearing rings show no indication of wear. No new parts were used in reassembling."

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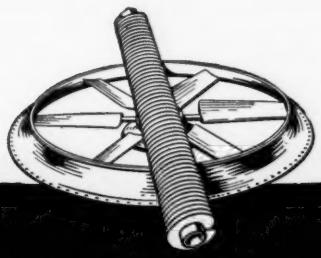

FIN-FAN *Air-Cooled* HEAT EXCHANGER

for every cooling and condensing service

Jacket water, lubricating oil, solutions and other liquids, air and other gases can all be cooled . . . steam, hydrocarbons and other vapors can all be condensed . . . *by air* . . . in the FIN-FAN Heat Exchanger, jointly developed by Fluor Corporation, Ltd. and The Griscom-Russell Co.

Think what this means to you in eliminating the complications, problems and expenses of a water supply system . . . no water piping, pumps, treatment, disposal or make-up; no corrosion, scaling, freeze-ups, or structural repainting due to use of water.

The FIN-FAN Exchanger is strongly constructed and highly efficient. It may be placed in any convenient location, and its effectiveness is independent of the velocity or direction of the wind. It is simple, easy and economical to operate.

WRITE FOR BULLETIN

Investigate this fully-proven and widely used unit. Its design, construction, and many important advantages are fully described in Bulletin 1230 which will be sent on request.

THE GRISCOM-RUSSELL COMPANY
285 Madison Avenue, New York 17, N. Y.

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GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

re-run savings paid for stokers

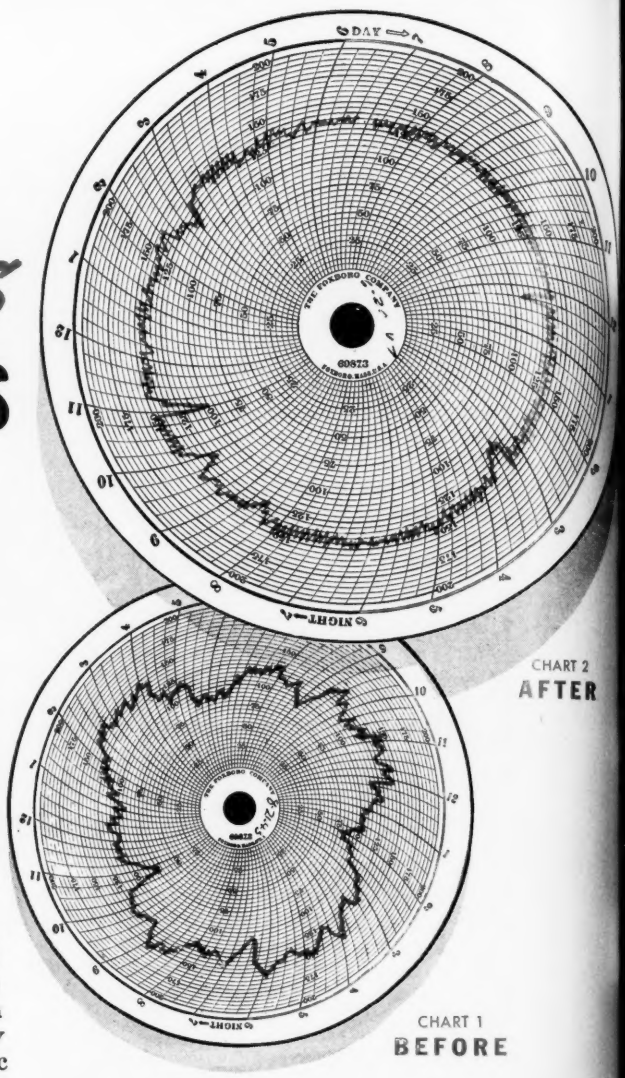


CHART 2
AFTER

CHART 1
BEFORE

The Taylor-Colquitt Company, of Spartanburg, S. C., are wood preservers, using a creosote impregnation process for poles, piles, ties and lumber. Process steam at constant pressure is a vital factor in securing impregnation to the desired depth. A pressure failure means a re-run for re-treating – and re-runs cost money.

Pressure Chart No. 1, illustrates the condition that caused frequent and expensive re-runs. To correct this, C-E Spreader Type stokers were installed under the existing HRT Boilers. What this meant in stabilizing steam pressures is dramatically illustrated by Pressure Chart No. 2.

Let J. D. Taylor, Plant Manager, tell the story: "The results obtained by this method of firing have been very satisfactory, and we have encountered practically no difficulty in maintaining a constant and satisfactory steam pressure. We are very enthusiastic about these stokers and take pleasure in recommending them. All automatic controls work perfectly and we are delighted with the results. Our processing has been much improved by being able to maintain a constant steam pressure at all times."

This was praise indeed. But, in addition, Combustion Engineering was informed by Taylor-Colquitt management that "re-treats" have been materially reduced since installing spreader stokers and that the stokers would *pay for themselves within a very few months.*

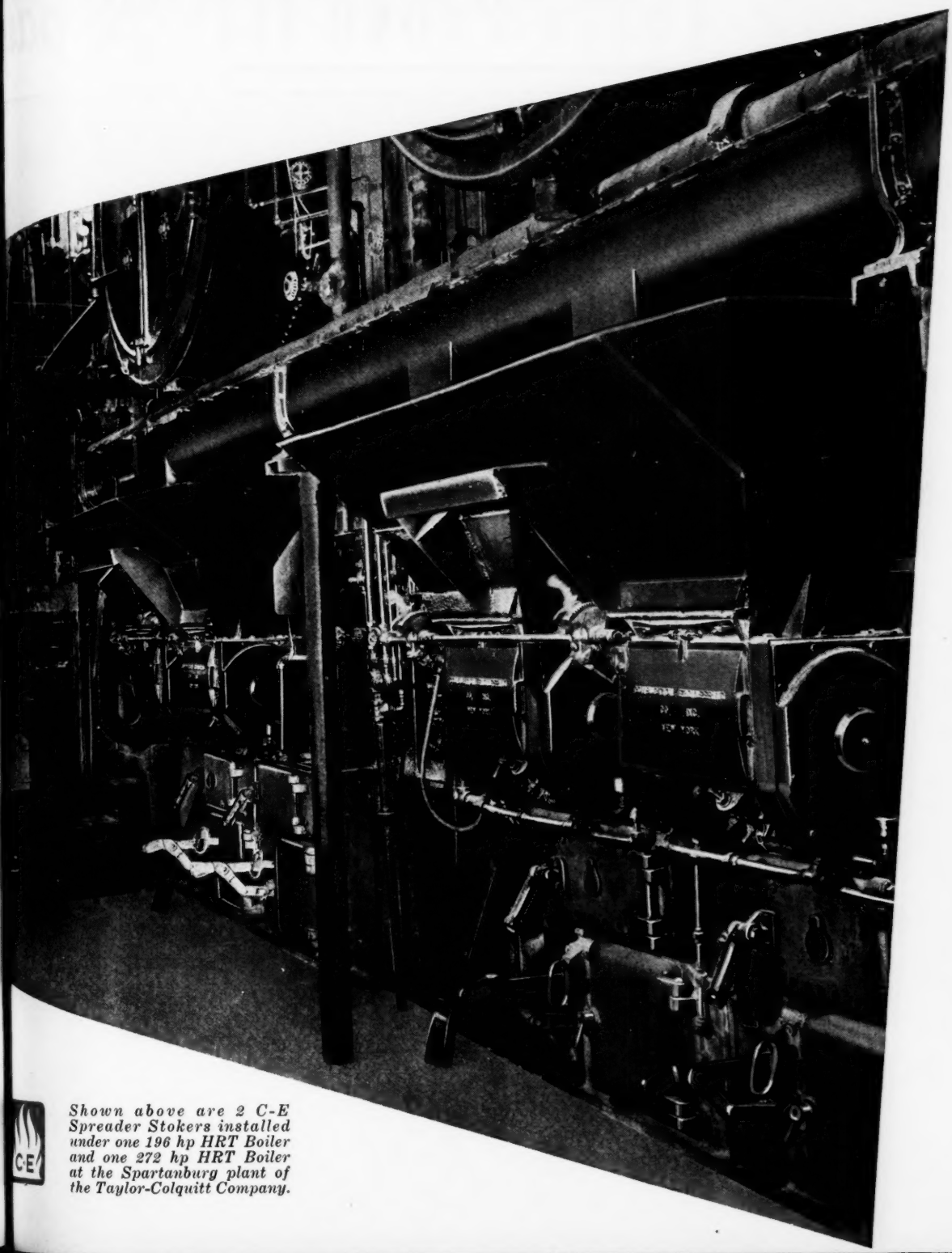
C-E is frank to acknowledge – and glad to credit – the exceptionally careful and intelligent operation of these stokers by Taylor-Colquitt operating personnel. And this combination of correctly designed equipment expertly operated is paying handsome dividends.

For hundreds of plants at home and abroad C-E spreader stokers have proved to be the one best answer to operating economy and efficiency. How about your plant? Our engineers will gladly work with yours to obtain the best solution, whatever your requirements may be.

B-173

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; ALSO MANY TYPES OF PRESSURE VES

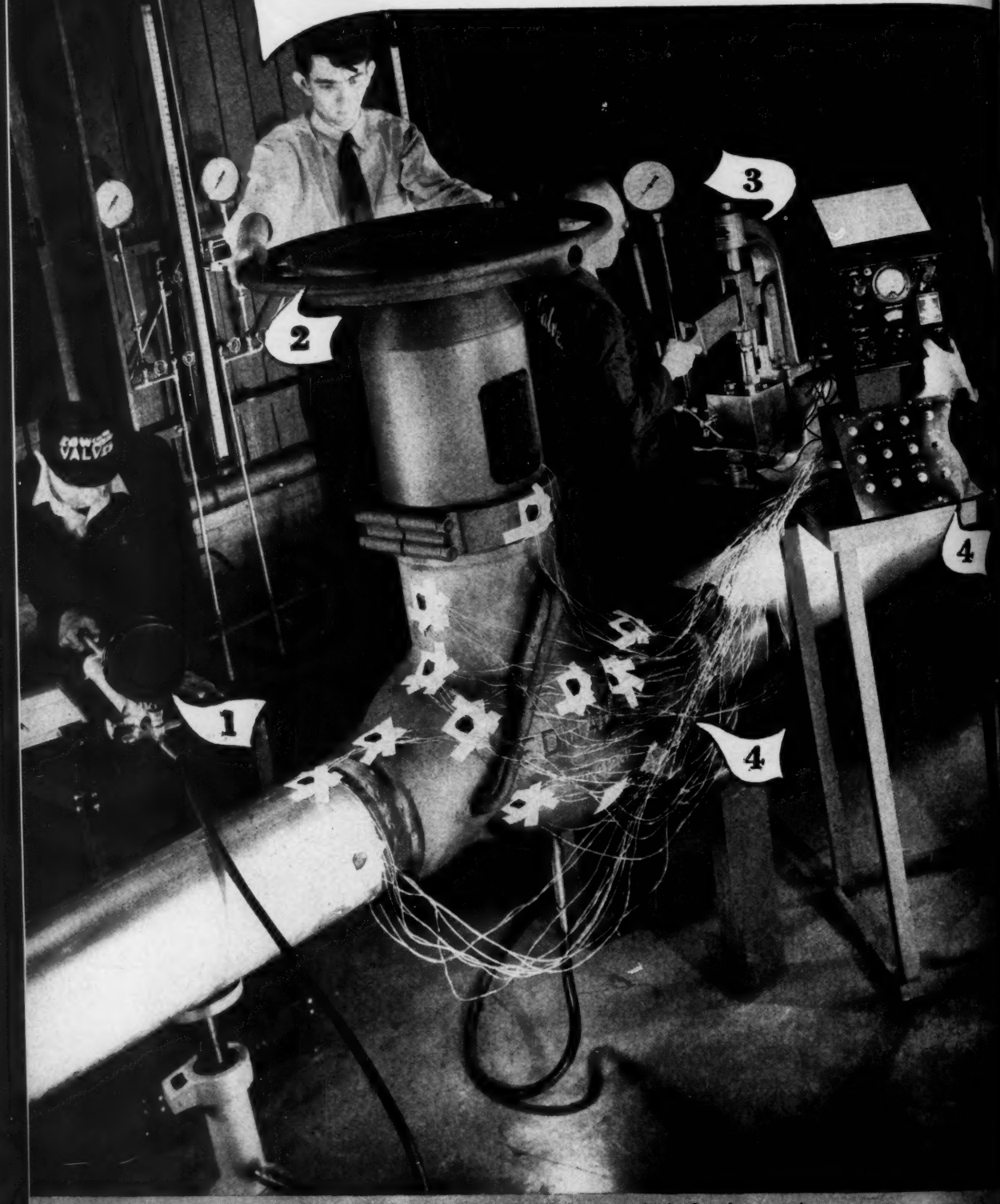


Shown above are 2 C-E Spreader Stokers installed under one 196 hp HRT Boiler and one 272 hp HRT Boiler at the Spartanburg plant of the Taylor-Colquitt Company.

C-E ENGINEERING

200 MADISON AVENUE • NEW YORK 16, N. Y.

Tests Prove It! It pa



Stress analysis of new valve design in which the three major stresses encountered in service are duplicated and measured.

1. Application of bending load simulating pipe line stresses.
2. Application of load resulting from seating valve with Edward Impactor handwheel.
3. Application of internal line pressure to
4. Measurement of resulting strains with SR-4 s gage equipment. Measures in millionths of an

Flow testing facilities in background

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XUM

...specify Edward STEEL VALVES

New Edward Designs Reduce Pressure Loss, Give Up to 30 Per Cent More Flow, Cut Wear-Producing Turbulence, Assure Maximum Strength

TRIAL AND ERROR is one way to develop valve designs—the old way—slow, inaccurate, uncertain.

THERE'S A BETTER WAY: The Edward pre-test procedure—an orderly, step-by-step, fact-to-fact progress that eliminates guesses and approximations.

IT STARTS with building a valve cross-section using modeling plastics, testing it, changing it, testing again and again until internal contours as near perfect as possible for free flow are developed.

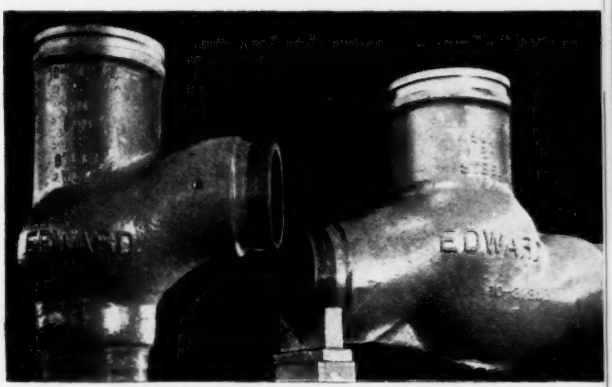
FROM THAT perfected model are made plaster casts of the flow passages, cross-section templates, patterns, and finally steel castings. Actual tests then prove the valve's flow rate and capacity, its freedom from excessive and erosive turbulence. A completely different set of tests prove the valve's structural soundness, its resistance to every strain, its shaping to compensate for distortions of high pressure, high temperature operation.

TO ESTABLISH this procedure Edward developed a whole new range of test equipment, much of it not duplicated anywhere. But it was worth it, for the results are definite and measurable. Typical are these

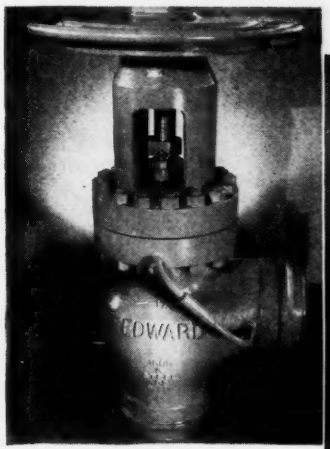
SPECIFIC ADVANTAGES

- Up to 30 per cent more flow (*more volume where you need it*).
- Less pressure loss (*smaller piping and valves often possible*).
- Less wear on vital parts (*sharp turns which cause wear-inducing turbulence are eliminated*).
- Safety (*engineered to proved safety factor*).
- Tighter (*built to compensate for distortions of operation*).
- Easier to operate (*because of Edward patented Impactor handwheel and EVal-thrust yoke bushing*).

Tiny streamers in test half-section model of new Edward globe valve show actual flow conditions. Test is one of many to guide Edward design engineers.



Body castings for new welding end Edward pressure-sealed valves. Wall shapes and internal contours are the results of years of original flow research. End threads are for shop testing.

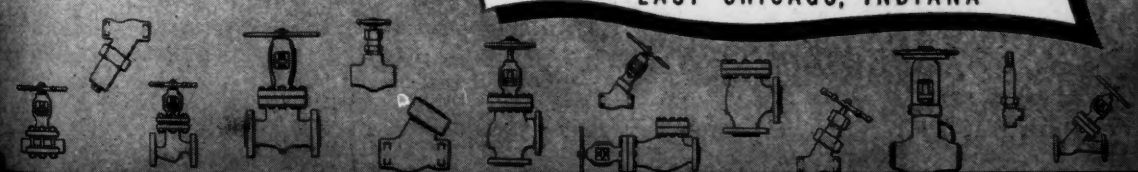


Two of the newer Edward valve designs. Left, 12 in. 1500 lb flanged bonnet angle; right, 10 in. 900 lb pressure sealed globe. Both have patented Impactor handwheel and Edward Equalizer.

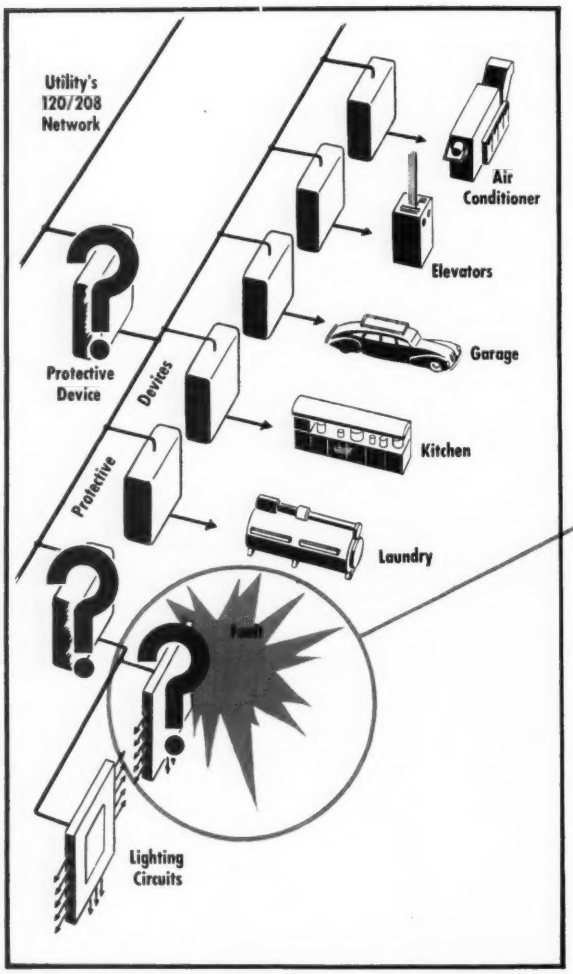
Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA



COULD YOUR PROTECTIVE DEVICES..... STOP ...PREVENT



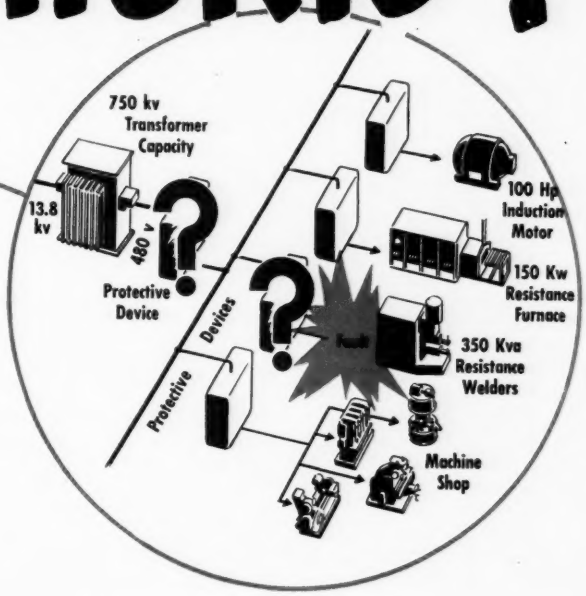
Because of the high kva capacity of a network system, bad shorts may draw tremendous surges of current that may blast protective devices of inadequate "IC." Loss of power to all facilities may result; equipment and personnel may be endangered by flying metal and fire. G-E air circuit breakers afford adequate "IC" protection, isolate shorts at their source, and do away with the possibility—and hazard—of over-fusing. Also, all costs of replacing fuses are eliminated. Be sure to check with your nearest G-E sales representative for complete information before installing protective devices on installations fed by a network system.

You're gambling with production, equipment, and personnel if your protective devices have inadequate "IC." Inadequate "IC" means that the device, whether it's an air circuit breaker, fused knife switch, or oil circuit breaker, **is** unable to handle the full short-circuit currents available on a low-voltage system. Under such conditions devices may fail, resulting in costly power shutdowns and loss of protection, besides hazards to personnel. Be sure of your "IC." Here's how . . .

KNOW THE "IC" of your low-voltage protective devices. The interrupting capacity of a circuit breaker or other protective device is the maximum current it is rated to ***adequately*** interrupt.

BE SURE THE "IC" IS ADEQUATE to interrupt maximum short-circuit currents. Maximum short-circuit current is ***not*** determined by the normal load on the circuit. The total capacity of the transformers feeding the circuit is the critical factor. In the adjoining table, check your transformer capacity against the "IC" corresponding to your particular circuit voltage. The interrupting capacity of your protective devices should be equal to or greater than the short-circuit currents available as determined by your transformer capacity.

THESE SHORTS ?



That protective device ahead of the fault should have an "IC" (interrupting capacity) rating of 25,000 amperes. Anything less* can mean danger in the form of a destroyed device, flying metal, or possibly flaming oil. If the protective device on the branch feeder explodes or fuses together because of inadequate "IC," it means a power shutdown in the entire plant with consequent production losses. If your installation is similar to the one shown, refer to the table below and check the "IC" of *your* protective devices.

*Some fused knife switches and oil circuit breakers may have a maximum "IC" of only a few thousand amperes.

POWER SHUTDOWNS

INSTALL G-E AIR CIRCUIT BREAKERS if you need more "IC." It's easy to select the proper G-E air circuit breaker from the table. And you can be sure they have adequate "IC" to safeguard your production, equipment, and personnel. By providing three-phase interruption of dangerous overcurrents, G-E breakers eliminate the possibility of single-phasing damage to motors. Workmen can operate these breakers easily. A turn of the handle and power is restored—no parts to be replaced.

WRITE FOR THESE BULLETINS on G-E air circuit breakers, or contact your G-E sales representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GEA-3600 AE-1 Air Circuit Breakers
GEA-3642 AL-2 Air Circuit Breakers
GET-1113 Selection and Application of Breakers
GET-1233 Short Circuit Currents in Industrials
GEA-2596 Low-voltage Metal-enclosed Drawout Equipment
GEA-3592 Load-center Unit Substations

INTERRUPTING RATINGS—G-E AIR CIRCUIT BREAKERS TO USE

Transformer Capacity in Three-phase Kva	220-240 CIRCUIT VOLTAGE				440-480 CIRCUIT VOLTAGE				550-600 CIRCUIT VOLTAGE			
	Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†	
	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use
300	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15	25,000	AE-1-25	15,000	AE-1-15
500	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15
750	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	50,000	AL-2-50	25,000	AE-1-25
1000	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50
1500	....	....	....	....	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50
2000	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	75,000	AL-2-75	75,000	AL-2-75
2500	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100
3000	....	....	....	....	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100

Note: This table is based on unlimited power supply and 5 per cent transformer impedance.
†If cascading of feeder breakers is used, it is possible that a smaller breaker may be used for branch-feeder service.

GENERAL ELECTRIC

860-52

THIS NEW THERMOCOUPLE TREBLES the Promptness of Micromax Superheat Control

With recent design improvements, Micromax Electric Control now detects changes in superheat temperature more than three times as quickly as earlier installations. The advantage applies to all five conventional types of superheat control mechanism; by-pass damper, Attemperator, condenser, spray, or burner elevation.

Our New High-Speed Thermocouple is responsible for the greater speed of temperature detection. Any thermocouple has inherent advantages as a temperature detector for superheat, because its low mass makes it quickly responsive, and its small size permits easy installation in the steam line. Our new thermocouple, designed specifically for superheat control, exploits this fundamental advantage by construction which assures maximum heat transfer in minimum time.

Anticipating Control Action is another advantage of Micromax control for superheat. The inherent time lag between change in boiler load and corresponding change in steam temperature of course affects any control of the latter condition, but Micromax circumvents this effect by initiating its control action as soon as there is a change in the rate of air supply to the boiler. Further control action is then of course based on the thermocouple.

Many advantages of Micromax stem from the use of electric control throughout—from the detecting thermocouple to the positive-action drive unit:

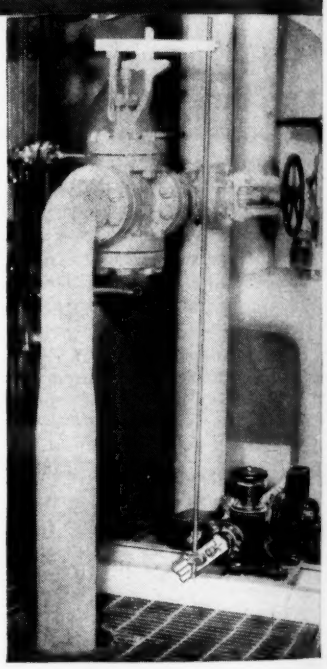
(1) The only power used is electricity; the most dependable of power sources.

(2) Dampers are positioned quickly and without overshooting, because the motor-driven reduction gears move with accuracy in applying the large torques necessary to handle the friction load.

(3) Dampers cannot move themselves in event of power failure; they are locked by the reduction-gear train. But they can.

(4) Valves, dampers, etc., can be moved by handwheels, if ever desired.

For analysis of any superheat instrumentation problem, consult an L&N engineer or send for Catalog N-33-163(1), as you prefer. Leeds & Northrup Co., 4973 Stenton Ave., Philadelphia 44, Pa.

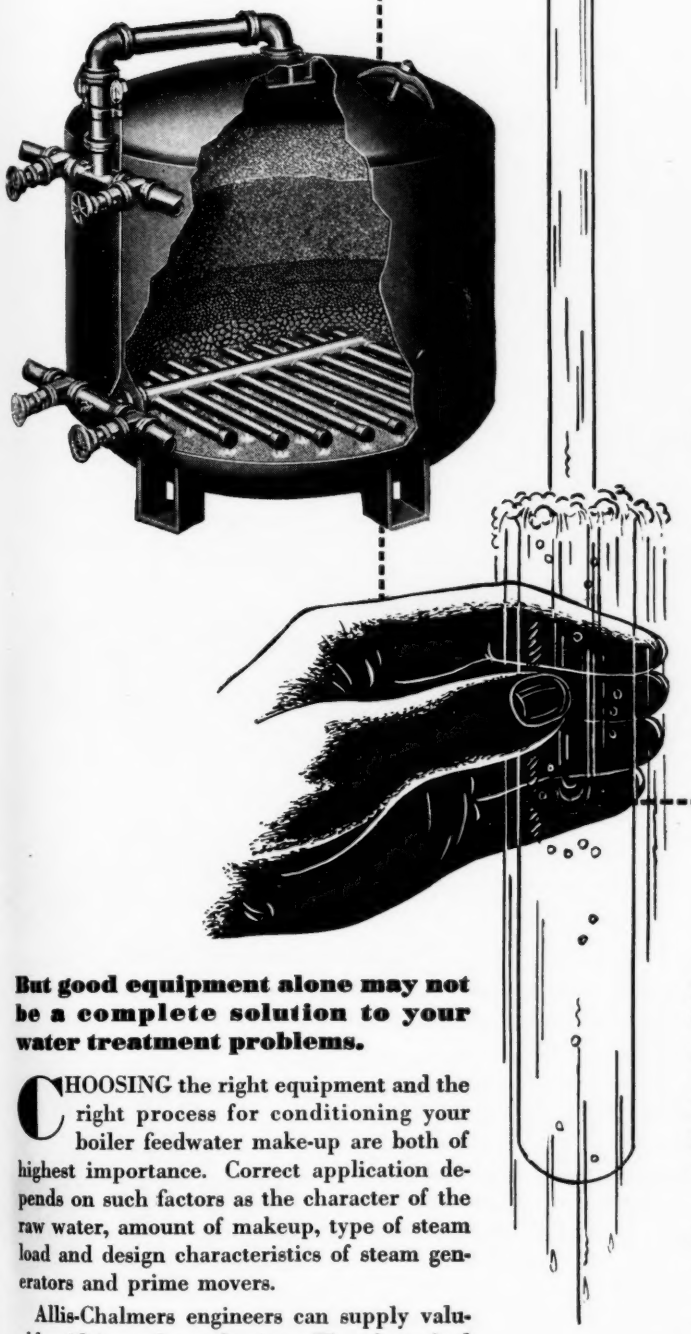


Drive Unit for Micromax Electric Control of superheat by the Attemperator valve shown. This picture's small units and simple linkage show principle in all M.E.C. Controls, whether larger or smaller.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad N-33A-463 (2)



Good Water

COMES FROM GOOD EQUIPMENT!

But good equipment alone may not be a complete solution to your water treatment problems.

CHOOSING the right equipment and the right process for conditioning your boiler feedwater make-up are both of highest importance. Correct application depends on such factors as the character of the raw water, amount of makeup, type of steam load and design characteristics of steam generators and prime movers.

Allis-Chalmers engineers can supply valuable aid in such a selection. They have had extensive experience in conditioning boiler water for both high and low pressure power plants. In addition, their recommendations will be unbiased, because Allis-Chalmers offers a complete line of equipment that includes Hot and Cold Process Softeners, Sodium and Hydrogen Zeolite Softeners, Degasifiers, Deionizers, Chemical Proportioners, Filter Backwash Pumps, and Oil and Water Filters.

For prompt assistance with any water conditioning problem, call your nearest A-C office or write ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2316

Shown above is sectionalized view of filter tank. Send today for complete details of Hot Process Softeners in Bulletin 28B6611.

ALLIS·CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

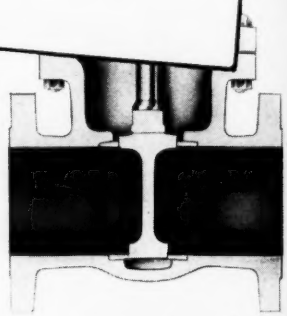
1847 1947
A CENTURY OF SERVICE to Industry THAT MADE America Great

Streamline

YOUR PIPELINES WITH

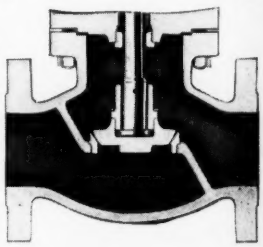
OIC
PACE SETTER IN VALVES

Free-Flow OIC Steel Valves Cut Pumping Costs . . . Give You *Maximum* Flow With *Minimum* Pressure Drop!



Streamlined.....

OIC GATE VALVES with flanged and welding end provide straight-through flow without recesses or pockets between the valve ports and seat openings. Screwed end valves are designed for the smoothest possible flow with a threaded joint.

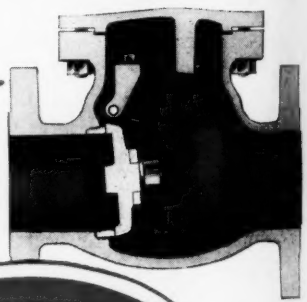


Streamlined.....

OIC GLOBE AND ANGLE VALVES are designed with a disc guiding in all pressure classes to eliminate the necessity of a bridge across the seat opening, thereby reducing pressure loss through the diaphragm to a minimum. Flow of the line fluid, whether gaseous or liquid, is expedited.

Streamlined.....

OIC CHECK VALVES have bodies designed for unobstructed flow where the disc is in the wide open position. Streamlined internal contours from port to port reduce turbulence and consequent pressure loss to a minimum.



SEND FOR NEW CROSS REFERENCE CHART

You can look at the figure number of the valve on the line and by referring to the Chart tell quickly the exact OIC Valve to order to replace it. To reserve your copy, write to:

THE OHIO INJECTOR CO.,
WADSWORTH, OHIO.

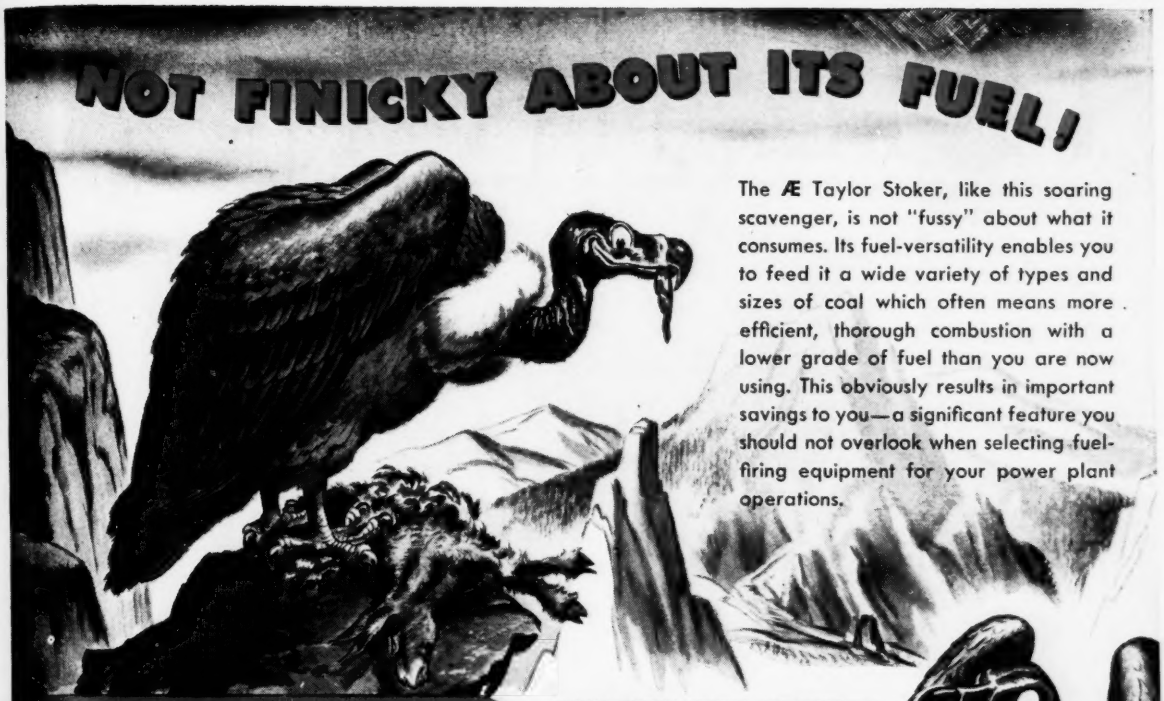
OIC

0-1047-1

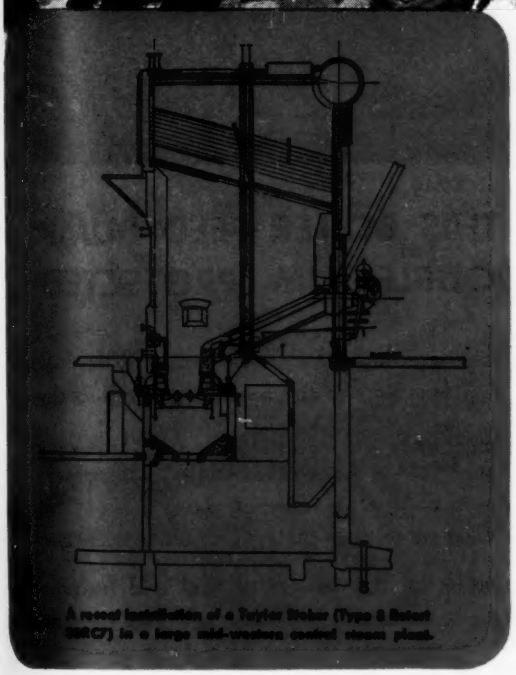
VALVES

STEEL-IRON-BRONZE

NOT FINICKY ABOUT ITS FUEL!



The Æ Taylor Stoker, like this soaring scavenger, is not "fussy" about what it consumes. Its fuel-versatility enables you to feed it a wide variety of types and sizes of coal which often means more efficient, thorough combustion with a lower grade of fuel than you are now using. This obviously results in important savings to you—a significant feature you should not overlook when selecting fuel-firing equipment for your power plant operations.



A recent installation of a Taylor Stoker (Type E Retort SSRCF) in a large mid-western central steam plant.

WATCH THE TREND!

It is quite probable that you are already acquainted with the exclusive Taylor features that make this fuel - flexible stoker first choice with buyers wherever underfeed stokers are used. Throughout industry, the trend is toward Taylor for both original and repeat installations —Taylor is the time-tested, proven, economy stoker.

Better air flow and precision control feed mechanism are but a few of the advantages that aid in giving you efficient low-cost steam generation. With simplified construction throughout, there are fewer moving, longer wearing parts. These outstanding improvements are backed up with over 40 years of engineering "know how" with emphasis placed on features that mean efficient, automatic, low-cost steam production.

Join the hundreds of engineers, plant superintendents and purchasing agents who specify Taylor for *their* power plant equipment. They know—*it's the leader.*

UP-TO-DATE FACTS ON THIS IMPROVED TAYLOR STOKER

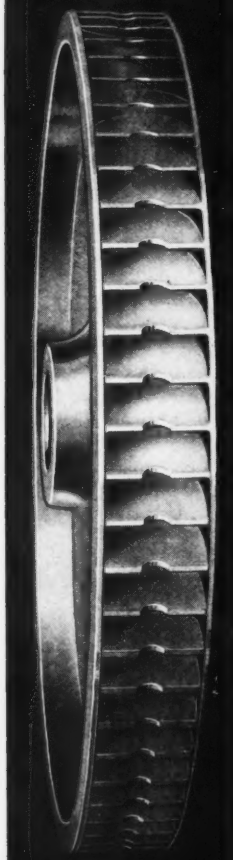
If you aren't up to the minute on Stokers, get your copy of this booklet. Write to Department 8 today!

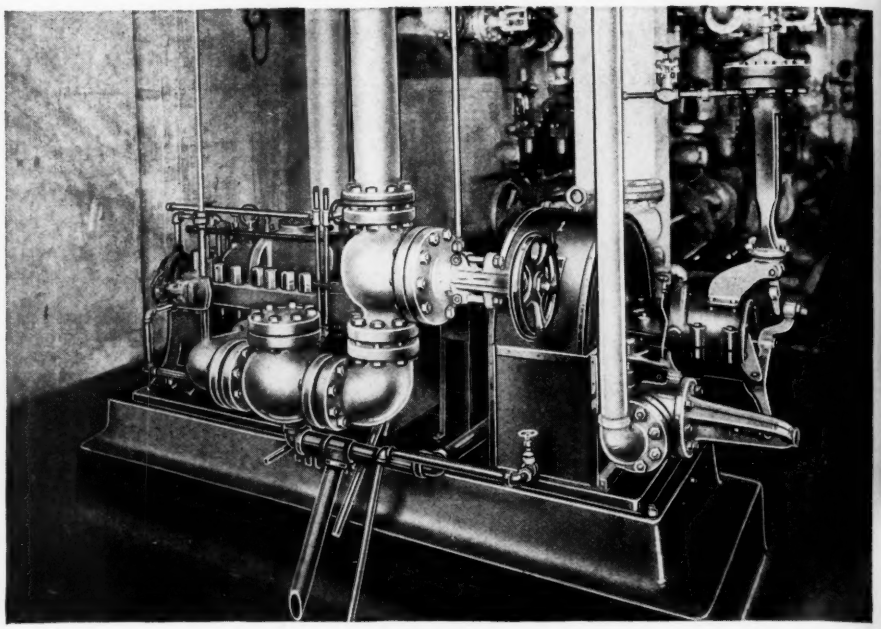
TAYLOR STOKER

AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

TERRY





THE BLADES OF THIS BOILER FEED PUMP TURBINE ARE DOUBLE RIM PROTECTED

The 55 H.P. Turbine shown above employs the Terry Solid Wheel Rotor. The wheel is made from a single steel forging and the buckets are milled directly in the wheel.

The buckets are protected by rims at the sides of the wheel as shown in the illustration at the left. These rims would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116.

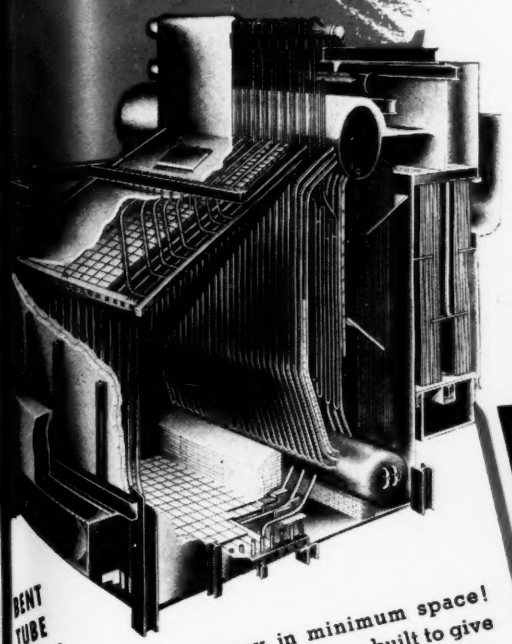
T-1170

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

SPRINGFIELD

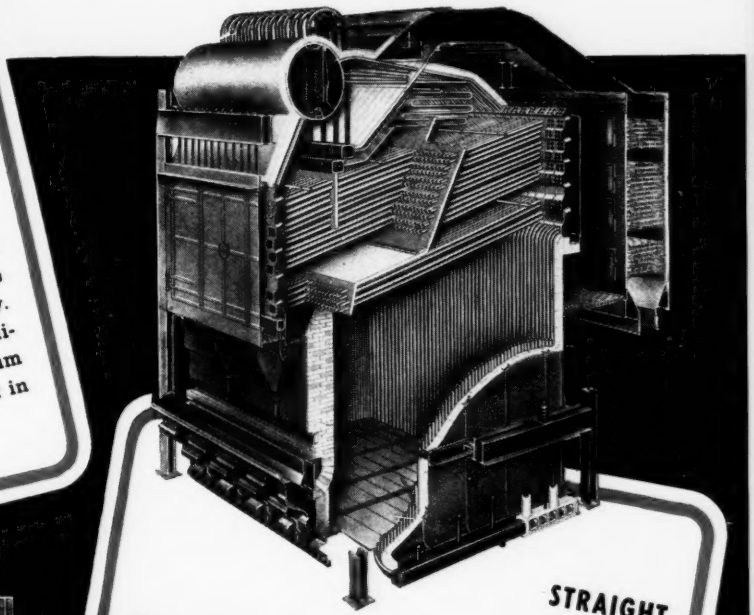
Boilers to meet your needs

SPRINGFIELD is building boilers for virtually every branch of industry: boilers for PAPER MILLS . . . high pressure boilers for UTILITIES . . . boilers for MEAT PACKING PLANTS . . . special boilers for CHEMICAL MANUFACTURERS . . . low pressure boilers for HEATING service . . . boilers for OVERSEAS. Springfield service includes design, fabrication, and erection of complete steam generating units with firing, draft, and control equipment—all taken on a "Single Responsibility" contract. *For boilers "to meet your needs," see Springfield!*



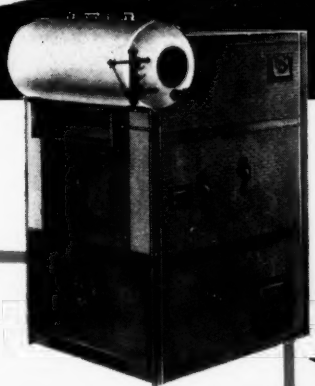
BENT TUBE BOILERS

● For maximum efficiency in minimum space! Carefully balanced Springfield designs built to give extra values in performance and dependability. Water cooled furnace. Gas flow distributed uniformly across width of unit. Dry steam. Minimum superheat variation over wide load range. Built in any capacity from 20,000 lbs. up.



STRAIGHT TUBE BOILERS

● A design preferred by many engineers. Big overload capacity; quick response to loads. High availability; less outage. Every quality feature you want in a boiler. Specially designed for capacities to 450,000 lbs. per hour and higher. Springfield patented center water wall construction available for large units.



TYPE M STANDARDIZED BOILERS

● Standardized for quicker delivery . . . lower cost. 7 sizes to choose from, ranging from 6,000 to 17,000 lbs. per hour. Built like a "BIG PLANT" boiler—*for the smaller plants!* Water-cooled furnace—all of Springfield's finest quality features.

ASK FOR LATEST INFORMATION

SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

Please send latest information on Springfield's:

☐ Bent tube boilers ☐ Straight tube boilers ☐ Type M boilers

☐ Center water wall furnaces ☐ Have representative call

Name _____

Company _____

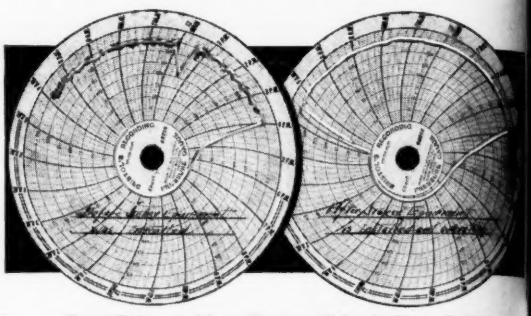
DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

40% COAL SAVING

Flexible Pneumatic Spreader Stoker Burns Coal and Wood-Waste Combination

IN the boiler room of the American Furniture Company, Martinsville, Virginia, an Iron Fireman Pneumatic Spreader stoker, producing high combustion-chamber temperatures with *auxiliary* coal fuel, is enabling the company to get most of its needed power from its own waste shavings and sawdust. Coal consumption is sharply reduced, being used only to generate the high temperatures needed to fire the wood waste. Mr. R. M. Simmons, President of the American Furniture Co., says: "Practically all of the material fed into the furnaces is consumed in suspension." This complete combustion reduces the smoke nuisance, and gets money-saving heat value even out of the wood particles which formerly escaped, unburned, up the stack. Since the installation of the Iron Fireman Pneumatic Spreader stoker, boiler room labor is very light.

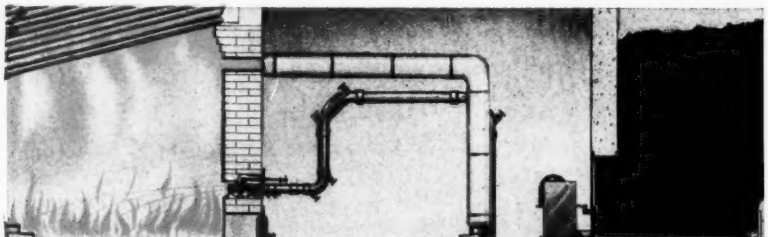
Steam pressure, so important in the correct seasoning of furniture woods, is remarkably uniform with Iron Fireman stoker firing. The recording chart shows a steady 175 pounds pressure. Compare the "before" and "after" pressure charts shown above.



Hand Firing and Iron Fireman Firing in Same Boiler

Left hand chart shows continuous variations of 25 pounds pressure and represents performance of furnace under hand-firing. Right hand chart gives clear picture of the even pressure maintained by the Iron Fireman Pneumatic Spreader stoker in this same boiler.

Installation is Flexible. To profit from the unique advantages of Iron Fireman Pneumatic Spreader stoking, you don't have to re-build your whole steam plant. This pneumatic stoker is EASY to install, whatever the boiler-room set-up may be. It is more than just adaptable—it is *flexible*. Operating through overhead pipes which leave the floor space clear, Iron Fireman's self-contained pneumatic coal-conveying system is easily "elbowed" into any boiler plant. Stoking mechanism can be located in front of the boiler, at the side, or even behind the boiler! It may even be located in another room, or on a different floor level. (This separation of stoking mechanism from direct furnace heat cuts maintenance costs and gives longer life to moving parts.)



IRON FIREMAN PNEUMATIC SPREADER STOKER. Steam size coal is metered from hopper or main coal bunker and transferred by pneumatic conveyor to furnace. Conveyor nozzle accurately spreads larger particles of coal over entire grate in a shallow, uniform fuel bed. Preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness, as compared with stokers which do not preheat coal.

COAL STOKERS AND OIL BURNERS FOR INDUSTRIAL FIRING

IRON

with Iron Fireman Stoker

Plant of the American Furniture Company, Martinsville, Virginia.

Boiler room of the American Furniture Co. Pipes inserted in boiler fronts are pneumatic coal conveyors. Wood refuse enters combustion chamber through three chutes shown at upper left.

Operation is Flexible. Thanks to Iron Fireman's exclusive Air Volumeter, which *maintains* correct fuel-air ratio *constantly* for maximum combustion efficiency, the Pneumatic Spreader stoker is highly responsive to fluctuating load demands. This sensitive combustion control permits the efficient burning of small size, low ash-fusion coals. Even sub-bituminous and lignite may be burned very efficiently. This adaptability of the Iron Fireman Pneumatic Spreader stoker to lower cost coals means greatly reduced operating expense. Similarly, this stoker is readily adapted to handle combination firing in which coal is used as a "booster" to permit the firing of local industrial waste-products. This means a further reduction in fuel costs.

Five-Fold Advantage of Pneumatic Spreader Firing

Conveyor fan in the stoker unit performs five important functions:

1. Conveys steam-size coal from pick-up chamber (to which it has been carried from hopper or bunker by conveyor worm) into combustion chamber of furnace.
2. Pre-heats coal for quick ignition. Coal-conveying medium is high temperature combustion gases from upper part of combustion chamber, mixed with air, and drawn through insulated pipe; then forced at high speed through coal pick-up section. This heating dries the coal, and raises its temperature almost to the flash point on its way to the furnace.
3. Spreads coal evenly over new-type grate by means of adjustable nozzle.
4. Provides pre-heated overfire air necessary for efficient firing.
5. Meets at right angles the flow of undergrate air coming up through fuel bed, producing maximum turbulence needed for complete combustion.

Don't GUESS about Your Steam Costs

Find out *exactly* what YOURS are. Request Iron Fireman's engineering survey and get an expert analysis of your present steam plant operation, without cost or obligation to you. Iron Fireman technical men have made thousands of these surveys to determine in advance what savings could be effected with Iron Fireman equipment. Their quarter-century of experience with every size and type of firing job is at your disposal. For this expert boiler-room survey, address: Iron Fireman Manufacturing Company, 3111 West 106th Street, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada.

IRON FIREMAN

FOR ALL TYPES OF POWER, PROCESSING AND HEATING JOBS

This special "Y" combines two 10-inch, standard weight, long radius welding elbows—TUBE-TURN Part No. 1, immediately available everywhere.
15" R.
120° ± ½°

"A speedy, simple, satisfactory answer"

MANY'S the time when a long delay in getting a special fitting seems unavoidable. Many's the time when that fitting can be fabricated from TUBE-TURN Welding Fittings out of stock and give you the right answer—"speedy, simple, satisfactory."

The "Y" diagrammed above was put together with standard TUBE-TURN welding fittings, shown in Tube-Turn Catalog No. 111, and taken out of regular stock. This gave the designer what he needed when it was needed, in a hurry.

TUBE-TURN welding fittings are particularly suitable for piping fabrication because of the uniform wall thickness and full circularity which allows them to be cut and joined at odd angles, and because of uniformity from fitting to fitting. Order two, a hundred, or a thousand TUBE-TURN welding fittings of the same size and part number, and they will be dimensionally alike.

TUBE-TURN welding fittings and flanges are manufactured in more than 4000 types and sizes. They come in a wide variety of metals and alloys. For details, contact the nearest TUBE-TURN distributor. For his name, write to—

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY
District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

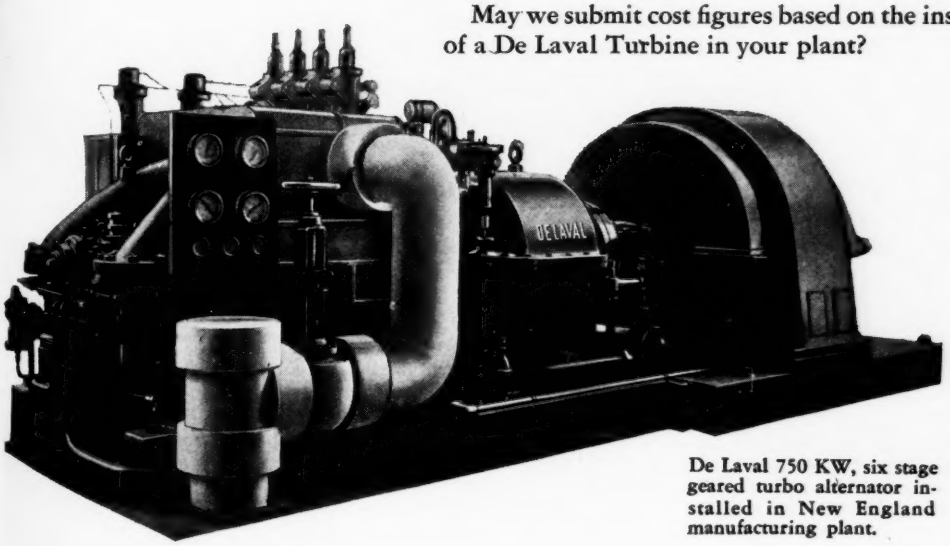
TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*

where there is HEAT there is POWER

Don't overlook the economy of generating your own power with a De Laval turbine wherever appreciable quantities of steam are required for heating buildings, dryers or processes.

In many installations the entire cost of the turbo-generators and auxiliary equipment has been repaid in two or three years. In fact, the installation of a modern high pressure steam plant often results in the production of both power and process steam at a fuel cost no greater than that entailed for the production of process steam alone, with older equipment.

May we submit cost figures based on the installation of a De Laval Turbine in your plant? T-6



De Laval 750 KW, six stage geared turbo alternator installed in New England manufacturing plant.

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NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois

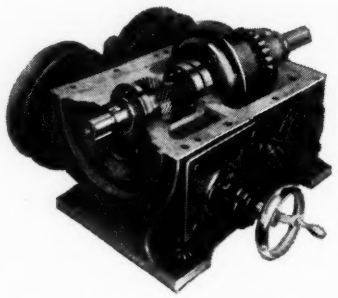
A Flow Slide-Rule. The Foxboro Co's. new Flow-Rule is a specially designed 12 in. slide rule for computing orifice plate bores, flow nozzles or venturi throats, and also the rate of flow, or the differential created across the orifice plate (whether flange tapped or full flow tapped) or other primary device. It can be used for all fluids, with or without seals, and covers such a wide range of flows and line sizes that it will handle almost any commercial problem. Although its average error is well within the accuracy of flow test data, it is not intended to replace computation methods where purchase and sale of fluids are involved. It will, however, be found to be invaluable for checking such calculations.

The cost of the rule, it is said, may easily be saved, many times over, where the correct determination of line size or flow rate is important. The great saving of time which the rule affords will be appreciated by all users. In a recent test demonstration before a group of industrial engineers the rule gave results in 2 minutes which, by the ordinary procedure would have taken from about 20 to 45 minutes, involving the use of curves, tables and a calculating machine. The accuracy of the Flow-Rule is closer than can be read without a magnifying glass.

Use of a Flow-Rule will be quickly understood by anyone familiar with a slide rule. All necessary instructions are on the back. The reversible slide has scales for gas on one side and liquids and steam on the other side. The use of color to distinguish the scales for such fluids adds to the instrument's convenience. Other color bands are shown, with tick marks indicating the id of Schedule 30, 40, 80 and 120 pipe.

The Flow-Rule comes in a case of heavy leather, equipped with a plastic window for the owner's card. The price is $25, and immediate delivery is assured while the limited supply lasts. Checks or formal purchase order may be sent to The Foxboro Company, Book Department, Foxboro, Mass.

B Variable Speed Reducer. Described as a wide range transmission unit, particularly suited to those installations where the ratio of maximum to minimum output speeds is large, is this new variable speed reducer. The range of the unit is 20 to 1 and it is available in sizes for between 2 and 15 hp. It is of compact design, only slightly larger than the driving motor, and thus is economical of space. In the smaller sizes the unit is available with a flange-mounted motor making a drive which meets still closer space requirements.



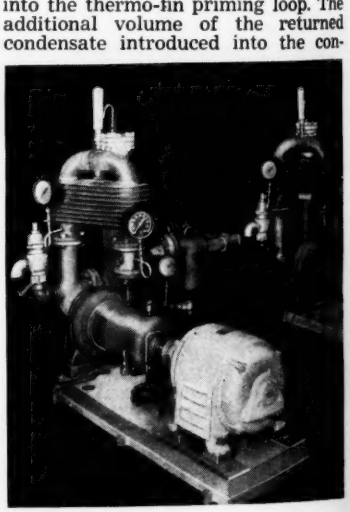
Power is transmitted through gearing in a straight line from the input to the output shaft making for convenient installation. Between the input and the output shafts is a planetary speed reducing unit. With an input motor speed of approximately 1800 rpm, the maximum output speed is usually about 175 or 220 rpm depending on the size of the unit. The minimum speed ranges down to slightly above zero.

The output speed is varied by means of an adjustabale speed-control belt which changes the rotation rate of the ring gear in the planetary speed reducer system by means of a worm and worm gear on the ring gear housing. The unit is announced by Lombard Governor Corp.

C Condensate Return System. To accomplish the return of condensate to even higher pressure boilers from presses, dryers, and other steam heated process equipment Cochrane Corp. has announced development of the new "CBA" High Pressure Condensate Return System. This new unit gives added capacity with lower horsepower motor ratings and can be used for return of condensate to higher pressure boilers. Similarly, lower pressure condensate can be returned direct to boilers in the 100 to 150 psi range than was formerly possible. For example, a standard 5-hp unit will handle 15 gpm at 50 psi differential and a 5-hp "CBA" will handle the same quantity at 150 psi differential.

The essential engineering features of the C-B high-pressure condensate return system insure thorough condensate and air removal from process apparatus making increased production possible by maintenance of uniformly high temperatures.

The especially-designed centrifugal pump draws water from the thermo-fin priming loop and discharges it as a high velocity jet through the jet pump nozzle. This jet, striking the returned hot condensate, induces condensate flow through the mixing tube into the thermo-fin priming loop. The additional volume of the returned condensate introduced into the con-



OCTOBER, 1947

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FIGURE 2228 LUNKENHEIMER NEW 200 LB. BRONZE UNION BONNET GATE VALVE

DESIGNED WITH FULL CYLINDRICAL BODY SECTIONS to provide maximum resistance against distortion of the valve body and seats due to pipe line stresses and internal pressure strains. Exhaustive tests made under conditions far more severe than those encountered in actual service clearly demonstrate that this design will not distort and will maintain initial proportions and seat tightness.

All parts are heavy and rugged and of the finest materials to insure ample factors of safety against pressure, temperature and operating strains.

Send for descriptive circular No. 534.

BUILT TO LUNKENHEIMER STANDARDS FOR BETTER SERVICE

NOTE THESE FEATURES

Malleable Iron Handwheel—Non-heat, easy, comfortable grip.

Rising Stem—Made of a distinctive silicon bronze alloy, developed and patented by Lunkenheimer. Remarkably wear-resistant, eliminates stem-thread failures. Exceptionally heavy stem head.

Hexagon Head Gland—Permits use of a wrench to loosen gland. Facilitates repacking.

Stuffing Box—Large and deep. Long thread provides solid engagement with packing nut to form a tight joint when fully packed.

Repacking Seats—Repackable under pressure when wide open. Repacking seats above stem thread, perfectly machined.

Bonnet—Union bonnet 2 in. and smaller; bolted bonnet 2½ in. and 3 in. Both provide a strong, tight joint; easily disassembled.

Body—Made of high grade bronze which meets the A.S.T.M. Specification B-61. Heavy, rugged proportions and straight through full flow areas.

Double-Wedge Disc—Nickel alloy, ball and socket bearing; no internal wedge or pin. Discs readily adjust themselves to taper seats, insuring a tight valve.

Stay-On Discs—Will not drop off stem when assembling valve. Bevelled disc wing guides and body channels make assembly easy.

PHONE YOUR LUNKENHEIMER DISTRIBUTOR

Fig. 2228 valves and companion valves are available through your Lunkenheimer Distributor. Call on him for prompt service and the best in valves—Lunkenheimer.

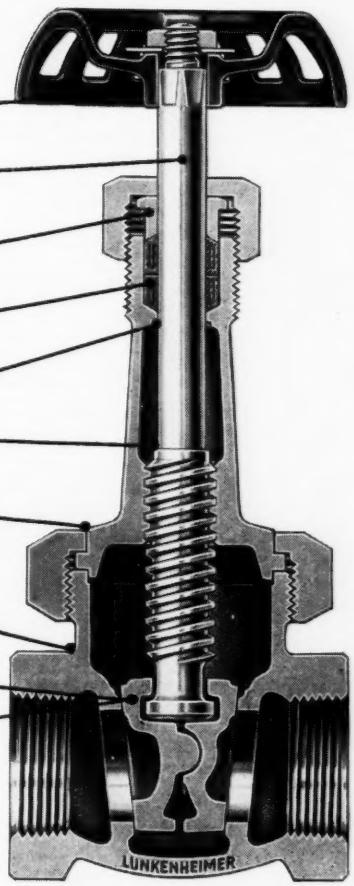

Fig. 2228

ESTABLISHED 1862

THE LUNKENHEIMER CO.

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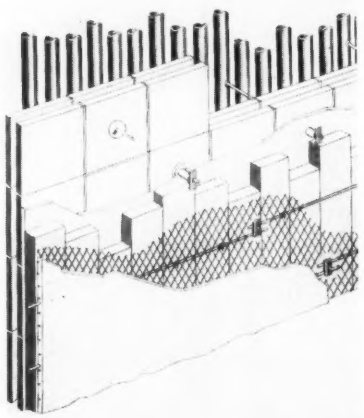
stantly filled loop results in the discharge of an equal volume of condensate through the air separator. Then after expulsion of the entrained air from the closed circuit, the condensate is returned to the boiler at temperatures close to that of process pressure without flash loss.

D New Wall Development. The backing of water walls consists of refractories, insulation and casing. The common practice has been for the brick layer tc lay up a section of tiles, the insulators to back these tiles with insulation, the boiler makers to hold the tiles and insulation in place on the outside by installing steel casings. Since all three operations must be done practically at the same time, one of the crafts is working while the mechanics of the other two crafts stand around and watch.

The George P. Reintjes Co. has developed a novel yet practical construction which permits all of the refractories for the entire boiler en-



closure to be installed before any insulation is applied. The insulation is applied in its entirety before the outer casing is installed. The outer casing can be left off until after the boiler is tested in service. In fact in many installations, the metal casing can be eliminated entirely.

This construction has many other obvious advantages, such as a pair of rotable refractories with elongated slots which automatically adjust the stud bolt to the tile it supports, eliminating field drilling or cutting. A combination tile anchoring and insulation holding nut is attached to the stud bolt but spaced away from the refractory the thickness of the insulation by metal sleeves and permits the insulation, whether blocks or blanket, to be rigidly supported without depending on wire mesh, wires, or other expedients. An outer casing of insulating materials reinforced with wire mesh is attached to the outside of the insulating holding rods in such a manner that this insulating casing is spaced apart from the inner insulation, thus permitting the inner insulation to move independent of the outer finish, avoiding unsightly cracking.

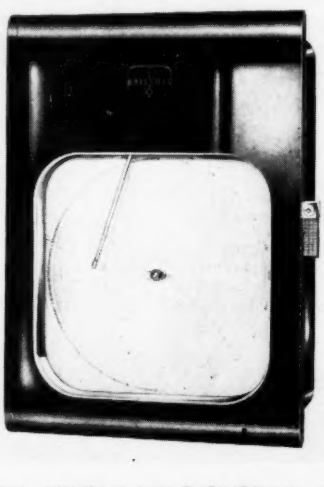
E High-Temperature Insulation. Owens-Corning Fiberglas Corp. has developed a line of light-weight high-temperature insulating materials, in felt and bulk form, which will withstand temperatures up to 1,800 F.

Composed of specially processed filaments of glass, the new line is designed for industrial, marine and aircraft applications where a need exists for a flexible, removable type of insulation that will maintain integrity and withstand physical deterioration at extremely high service temperatures.

In felt or bulk form, the new high-temperature materials are suitable for insulating housings and flange covers of high-temperature steam turbines, and exhaust manifolds and turbo-supercharger housings on oil or gas-fired supercharged 4-cycle Diesel engines. In many other applications they can provide a removable and replaceable insulation that can take the place of the refractories, up to now alone available for use in insulating such high-temperature equipment. They can also be employed as the filtering element in fly ash separators used in high-temperature processing equipment.

F Recording Thermometers, Gages. A new line of recording thermometers and recording gages known as the Series 500 line of recorders has just been announced by The Bristol Co. These instruments operate on the same basic principles as those used in recording thermometers and gages built by the company for many years. They are, however, housed in a newly-developed modern case and have incorporated many design improvements to make them easier to use, more convenient to service, and readily convertible from one type to another. In addition, the company has, wherever possible, simplified the construction of the instrument.

The case is designed so it can be mounted either on a wall, front of panel, or flush on a panel and can be easily converted by the user at any time from one type of mounting to another. Other case features include a heavy inlaid sponge-rubber door gasket, flush roll-type door handle, and non-projecting door hinges.



The mounting block, which holds the external connections to the instrument, is removable. It can be mounted either on the bottom or back of the case and can be changed at the discretion of the user from bottom to back of the case or vice versa and is designed for easy removal of the measuring element system.

Pen arms are pivoted on stainless steel journals with the pen-arm shaft supported at both ends in a rigid one-piece mounting. The journals are ground and polished to provide low-friction action. Link members between the measuring element and pen-arm mechanism are readily removable without tools and can be equipped with over-range and under-range two-way springs when required. Improvements have been made in the measuring element to improve its accuracy and the ease with which it can be adjusted.

Series 500 Recording Thermometers and Gages are furnished in 8-in. and 12-in. sizes in a wide variety of ranges.

G Anti-Rust Paint. Speco, Inc., has announced that Rustrem anti-rust paint is now available in aluminum as well as in black.

This new paint, according to the manufacturer, can be applied right over rust without brushing or scraping. It is reputed to immediately penetrate the rust layer, render it inactive and seal the surface against further rusting.

Other features claimed are high resistance to chemical action and immunity to climatic changes.

It is especially recommended for use under water, in salt water, or in locations where dampness and moisture are ever present. Rustrem Aluminum can be painted over with any high quality paint or enamel.

H Industrial Air Conditioner. The Niagara Blower Co. announces an improved air conditioner for highest precision in scientific and industrial applications.

Identified as a saturating spray "Type A" machine, it operates on the principle of saturating air with moisture at a given desired dewpoint temperature and then, by re-heating, producing the exact condition of relative humidity and temperature needed in a laboratory, manufacturing or process space, or for impingement on a product as in many continuous drying operations and where uniformity is of paramount importance.

New designs of cooling and heating coils and spray arrangement for great turbulence achieve saturation of air in an exceedingly small floor space. The entire apparatus illustrated occupies 7½ sq ft and delivers 2,000 cfm of air. Other models requiring up to 50 sq ft give air delivery up to 20,000 cfm.

The conditioner illustrated has a casing of stainless steel welded into an integral unit for the utmost dependability of service under conditions inviting corrosion.

Controls provide for holding or varying at will the conditions of rela-

Steam . . . water . . . oil . . . or gas
CRANE Supplies all Piping equipment

. . . A good thing to remember for a simplified piping job every time . . . on new or replacement installations. No matter what the fluid or working conditions, see the Crane line first for *all* piping equipment . . . and for dependable quality in every item.

For this water supply system, for example, the Crane Catalog puts everything at your finger tips . . . valves, fittings, pipe, and pipe line accessories. One order to your Crane Branch or Wholesaler covers all your needs. From design to erection to maintenance, your piping job moves fast and smooth . . . with good performance assured . . . because you get this 3-way advantage:

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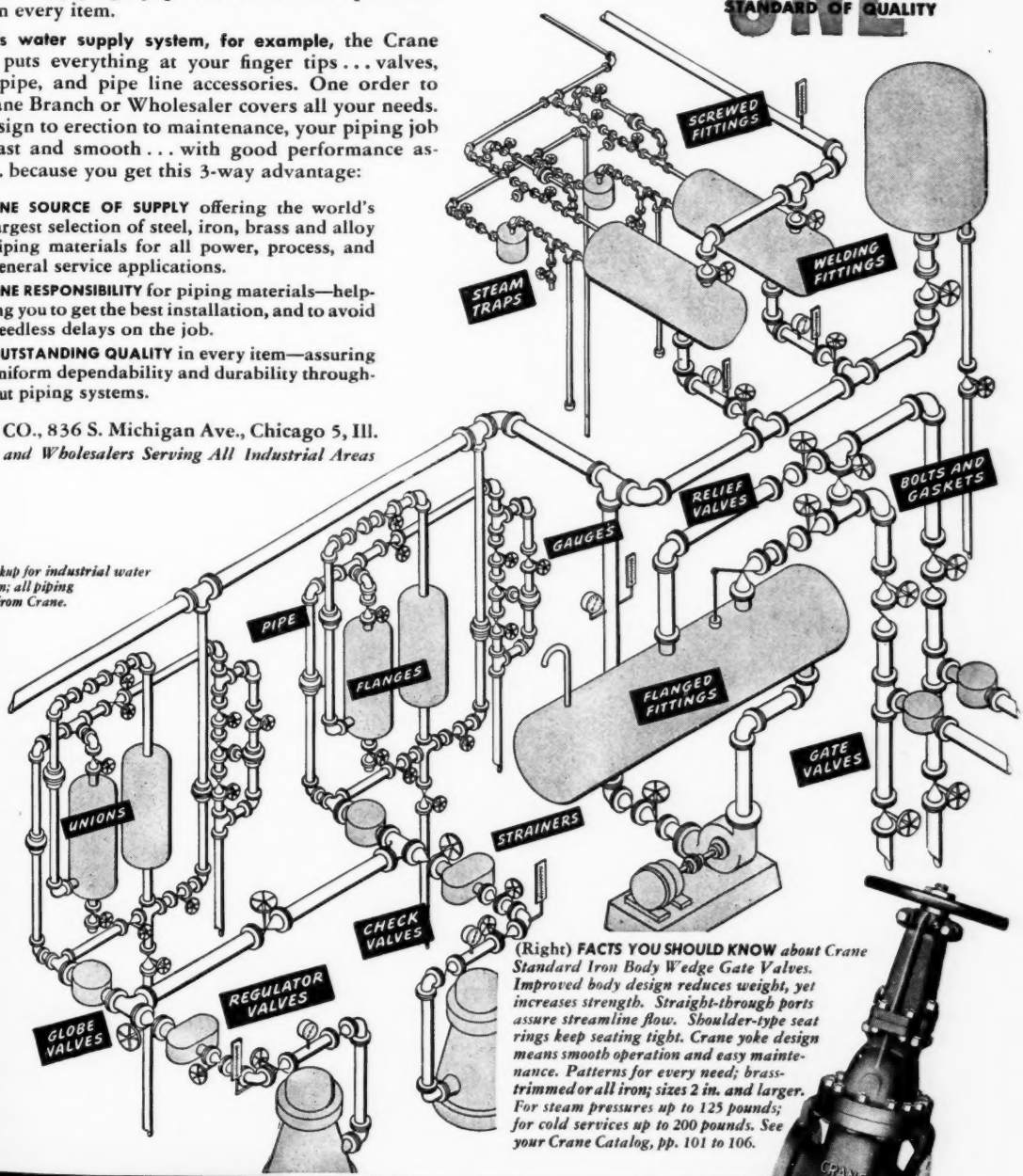

Typical hookup for industrial water supply system; all piping equipment from Crane.

(Right) **FACTS YOU SHOULD KNOW** *about Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight, yet increases strength. Straight-through ports assure streamline flow. Shoulder-type seat rings keep seating tight. Crane yoke design means smooth operation and easy maintenance. Patterns for every need; brass-trimmed or all iron; sizes 2 in. and larger. For steam pressures up to 125 pounds; for cold services up to 200 pounds. See your Crane Catalog, pp. 101 to 106.*

EVERYTHING FROM . . .

VALVES • FITTINGS
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AND HEATING

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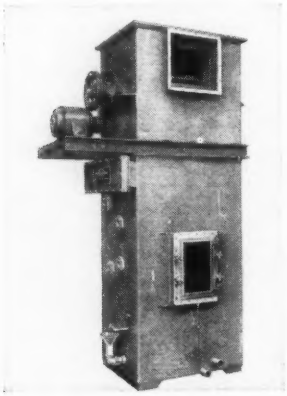
tive humidity and temperature between 40F and 125F dewpoint temperature with extremely close tolerance. A dry bulb variation of 1F might mean a variation of 4 per cent

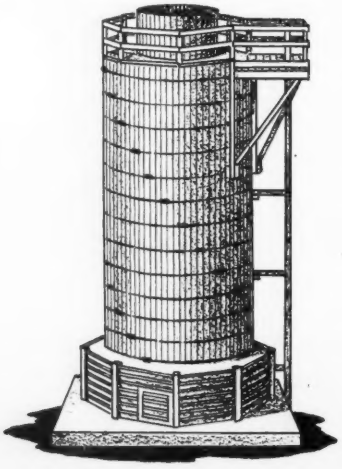


or 5 per cent in relative humidity. Lower temperatures can be obtained by using Niagara "No Frost" Liquid in the spray solution.

Applications for the equipment are in industries and laboratories handling hygroscopic materials, including paper, textile, forest products, photographic film, rayon, cellophane, foods, drugs, instruments, and pharmaceutical chemical and biological processes. It is also used for obtaining the most efficient heat transfer between a liquid in a tube and air by means of evaporation.

J Cylindrical Cooling Tower. Patent disclosures by the Santa Fe Tank and Tower Co. reveal a new development in cooling tower construction and design, the Cylindrical Tower. The new Cylindrical Tower is the first of its kind having been conceived by Santa Fe engineers only last November.

In making this announcement of a new addition to its line of cooling tower equipment, the Santa Fe Tank and Tower Co. stresses the fact that the underlying principle, design and construction is entirely new. Most important of all, the Cylindrical Tower



is designed to eliminate dead air spaces.

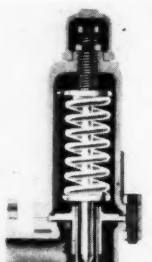
The noteworthy feature of circular design allows air to enter the tower from any point of the entire 360 deg circumference, instead of from only two sides—or two sides and four corners. This significant factor accounts for a more even distribution of air, and also reduces the need for baffles or diverters, according to the announcement.

The construction of the tower allows loads imposed by wind loads to be reduced; in turn, reduces loads imposed on supporting structures, such as buildings, sub-structures or concrete foundations.

The Cylindrical Tower may be built in either individual or multiple-cell units . . . either of wood or steel construction.

The Cylindrical Tower can be furnished in single wall construction (2 in. nominal) or in double wall construction with the inner wall of 2 in. nominal thickness; and the outer wall of 1 in. nominal thickness or less.

K Acid Resistant Valve. To meet an insistent demand for a valve that can be used in corrosive service, principally from process and petroleum industries, Farris Engineering Corp. has developed a line of corrosion resistant safety and relief valves that promises to effect



a marked reduction in valve maintenance costs on installations handling corrosive vapors or gases.

This end is accomplished by two factors in the design: 1. The use of Haynes Stellite Co. "Hastelloy-C" for the inserted nozzle and the valve disc and, in certain models, for the complete valve body. This alloy is a hard, tough, corrosion resistant, nickel-iron alloy containing molybdenum, silicon and copper, which is proof against the corrosive action of any of the acids or caustics normally handled on a commercial scale.

2. The complete isolation of all working parts of the valve behind a vapor proof "FarriSeal" curtain. This protective seal is a flexible material attached to the disc at one end and the flanged disc guide at the other, in such a way as to completely isolate the working parts from the gas or vapor within the body of the valve. The materials of the seal may be of either rubber, "Neoprene" or any flexible metal designed to withstand the action of specific acids or caustics.

These two design characteristics, coupled with the recognized advantages of the nozzle throat; the high disc lift which permits full capacity discharge; the long low-stressed, protected loading spring; the precision alinement of spring and disc; and the top-loaded free-acting disc guide result in a line of valves designed to provide maximum service with minimum maintenance.

Available with flange connections in sizes from ½ in. to 2 in.; with screwed connections in sizes from ½ in. to 1 in.

L Universal Tachometer Head. A versatile tachometer head is now available for all speed measurements between 100 and 10,000 rpm. Reliability and freedom from

maintenance have been stressed in the design and construction. It contains only one rotating part which is mounted in permanently lubricated ball bearings. No gears, brushes, or flexible shafts are employed. Electrical connections are made through ½ in. conduit or fittings to inside terminals. All parts are adequately sealed against dirt. These heads can be operated in any position and are useable with any of the company's indicators or recorders. Direct coupling without need of a speed changing drive is provided for all speed ranges.

A sturdy case of aluminum provides a rugged, lightweight unit (14 ounces). Their small size permits easy mounting in cramped quarters. Dimensions are $2\frac{3}{16}$ in. by $1\frac{15}{16}$ in. by 5 in. Operating torque is approximately $\frac{1}{30}$ ounce-inches.

Mounting is provided by tapped holes in both bottom and end and it may be used with the Type 66 pedestal mount.

Standard SAE marine fittings for this head are available for use directly on gasoline and Diesel engines. The head is also designed to accommodate AN specification electrical connections. It is announced by Metron Instrument Co.

M Steel Factory Sash. Hope's Lok'd Bar Steel Factory Sash are designed for greater strength and weather-tightness in industrial buildings having large glazed wall areas, and for longer life under conditions of exposure and corrosion, as in chemical process plants, food industries, wherever there are special requirements for sanitation or weather-tightness, and in industrial areas that create difficult conditions for maintenance it is pointed out in a recent announcement.

Vertical sash bars are bulb tee sections approaching the I-beam type of section in strength. In the "Lok'd Bar" joint, the flat tee horizontal muntin is threaded through the bulb

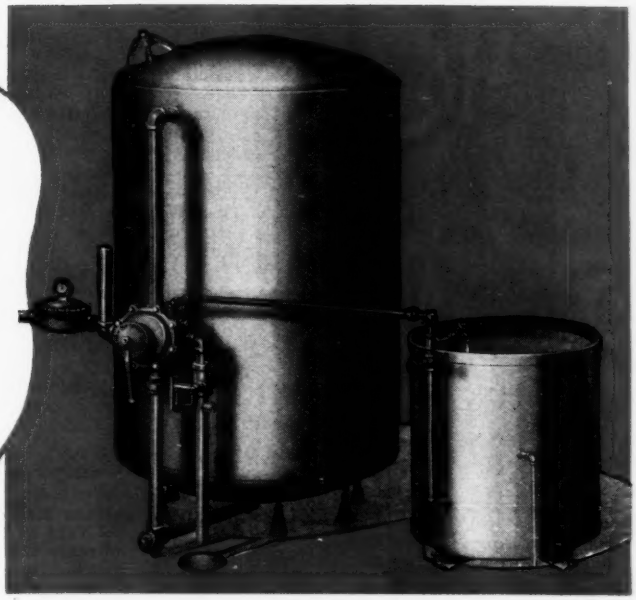
21,000 EXTRA GALLONS

of soft water per regeneration!

That's what the

ELGIN WATER SOFTENER

gives at no extra cost!

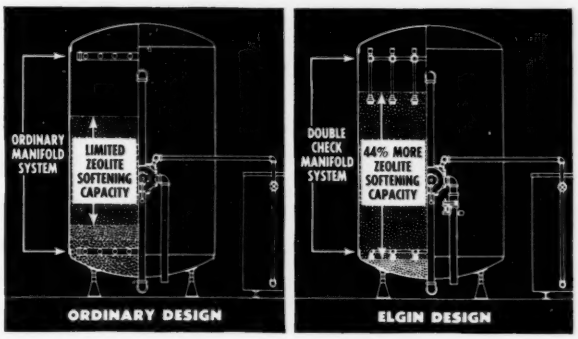


There's no secret about it! The drawings show the big improvement in the Elgin Water Softener that does the trick . . . gives you up to 44% more soft water . . . for example, 21,000 more gallons per regeneration from a 42″ x 72″ softener handling ten-grain water than is delivered by the ordinary water softener.

This basic improvement is the Elgin "Double-Check" arrangement. It's one of those why-didn't-someone-think-of-it-before ideas—a manifold arrangement which prevents the escape of zeolite under all operating conditions. By so doing it permits a far deeper bed of zeolite in a softener of given size, and of course more zeolite means more soft water output. Also, by preventing zeolite loss, a higher backwash rate is made possible. This cleans and opens up the zeolite bed thoroughly —means better and quicker regeneration with less salt consumption.

There's no question about it! The story of extra gallons of soft water is being told in daily service by Elgin "Double-Check" installations in more than 3000 plants. Their ability to save dollars in first cost, in operating cost, in maintenance cost is indelibly written into the records of plants like yours.

And note this: Existing softeners, regardless of make, can be modernized by Elgin to incorporate the features and advantages of this "Double-Check" design.



Whatever your water conditioning problem Elgin has the answer—While the Elgin "Double-Check" Softener represents the zeolite water softener at its best, it is not the answer to every water conditioning problem. Such is the scope of Elgin equipment and methods, however, that we are in a position to give you an unprejudiced recommendation covering your particular needs. One of our district engineers would like to show you how we can solve your problem. No obligation whatever.

Ask for this new bulletin—It describes the design and advantages of this revolutionary water softener.

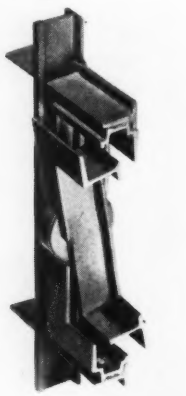
ELGIN SOFTENER CORPORATION

136 N. GROVE AVE., ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

tee, both with the least distortion of the metal and the least detraction from solid bar strength. The weight of the section is heavier and the strength of the joint is demonstrated to be double that of conventional sash.

Ventilators are complete casement and frame units, solid welded at corners, reinforcing the sash where they occur. Ventilator sections are rolled in one piece with the weathering



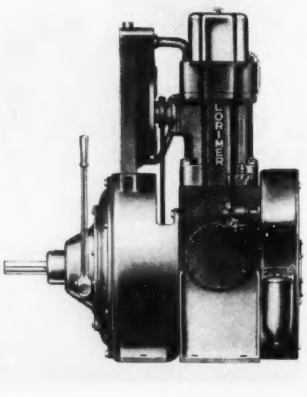
flanges integral, avoiding the applied weathering construction which invites corrosion. Air infiltration is less than 1 cfm air at 25 mph wind pressure.

Ventilators, when projected, are hung on heavy steel side arms pivoted to the frame at the jambs; when pivoted, they are pivoted on pairs of solid bronze cup pivots. Hope's Lok'd Bar Factory Sash are Bonderized and finished with baked-on coat of rust inhibiting primer. Standard sizes are carried in warehouse stocks and custom-built windows are shipped from the factory. These steel windows are manufactured by Hope's Windows, Inc.

N Small Diesel. Known as the "Sturdy Scot," a new single-cylinder stationary Diesel engine is now in production at Lorimer Diesel Engine Co. plant.

A vertical 4-cycle full Diesel, the "Sturdy Scot" has a bore of 5¾ in. and a 7½ in. stroke. Horsepower is 10 at 600 rpm, 12 at 720 and 14 at 800.

Principal feature of the engine is its simple, rugged design and slow-speed operation. The 3¾ in. diameter crankshaft is carried on two Timken roller main bearings; force feed lubrication is provided for main, crankpin and wristpin bearings. The piston is 9⅛ in. in length and carries five rings. Fuel system consists of standard heavy duty pumps and injector. Heavy-duty filters are provided for both fuel and lube lines.

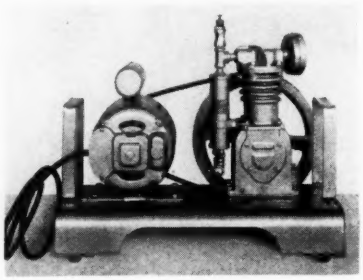


Standard equipment includes governor, lube pump and lube filters, tools and instruction manual. Optional equipment includes power take-off clutch, heavy-duty radiator, water pump, fuel transfer pump, electric or air starting equipment, or impulse magneto for manual-gas starting.

Standard models are full diesels; models for operation on natural gas are available on order. "Sturdy Scot" 10 kva generator sets are also available.

According to Lorimer engineers, the slow-speed heavy duty design of the "Sturdy Scot" permits long periods of continuous service without attention and assures maximum service life. Simplicity of the engine makes it possible for any ordinary mechanic to start, operate, service or overhaul it without difficulty.

O Air Compressor. Some users often need compressed air power at various scattered locations and these jobs vary so much as to location and distance that air pipelines and hoses attached to a central compressor are not practical. Furthermore, they result in losses in air volume and pressure. Lightweight, portable air compressors have only partially solved the problem. For the



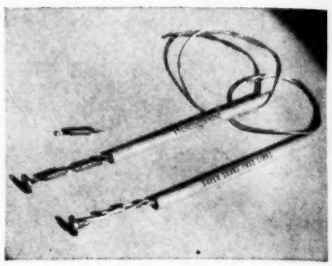
usual lightweight, portable air compressor was built to provide low air pressure and high air volume, with the result that air pressure was too low for certain types of work.

To meet this need more satisfactorily, American Brake Shoe Co., Kellogg Division, has developed the new, small, lightweight A-140-XS. This air compressor is carried easily from place to place. Yet it delivers 3.3 cfm displacement on continuous operation at 130 psi. This is sufficient for inflation of tractor and truck tires, and greasing. Moreover, by attaching a regulating valve when needed, pressure can be reduced for paint spraying, insecticide spraying, and similar uses.

The A-140-XS includes a standard compressor with safety valve and pulsation chamber, and ½ hp electric motor, mounted on a rugged base that is equipped with two large handles for easy carrying.

P Fuse Links. Lightning surges and temporary heavy loads within the permissible range of transformer thermal capacities can be carried safely by a new line of primary distribution fuses announced by the Westinghouse Electric Corp. Designed especially for transformer fusing, the new links are of the universal type for any indicating or non-indicating NEMA standard distribution porcelain cutout box up to 15-kv rating.

The new Super Surge fuse links

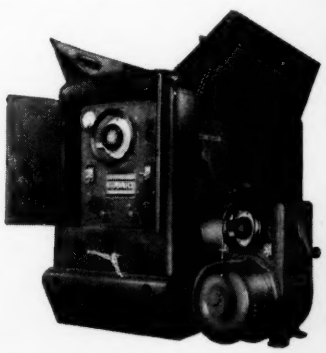


will blow on sustained overloads like any "N" rated fuse but will continue to carry the current during short-time heavy loads within the thermal capacity of the transformer or when carrying lightning surges within the transformer surge level that would operate the conventional fuse under a 15-amp size. The time-current curve of the new link is identical with the American Standards Association safe loading curve for small distribution transformers. This makes available most of the thermal overload characteristics of the modern transformer while a better protective ratio for transformer fusing can be obtained.

Fuses are available in the 1, 2, 3, 5, 7, and 10-amp sizes.

Q Arc Welder, Power Unit. The Hobart Brothers Co. is announcing a new type of arc welder and power unit combination.

This is a new full capacity 200 amp rotary a-c arc welder for construction, maintenance, and repair welding. It includes a simply-operated change over switch to convert the welder generator into a 52 amp, 120 v, 60 cycle, 5 kw, 6.3 kva, single phase power unit. In this machine, you not only get full capacity 200 amp a-c welder, but an a-c power unit which will supply sufficient power to operate 50 100-watt lamps



You Can See for Yourself . . .

WHY the Foster 38-SV Safety Valve is ESPECIALLY SUITABLE FOR

HIGH PRESSURES HIGH TEMPERATURES

Pressures up to 3000 pounds and temperatures of 1200° F. are easily handled by the Foster Type 38-SV Super-Jet Safety Valve—it was designed especially for just these exacting requirements! It's no mere "beefed-up" low-pressure valve—rather it's a basic new design for high-pressure service.

Only the Foster 38-SV Safety Valve gives you all these advantages:

1. . . ***Exceptional steam economy*** because . . . it reseats as low as 1% below popping pressure . . . reseating is positive; without pounding or chatter . . . blowdown is adjustable from 8% down to 1%.
2. . . ***Unaffected by temperature changes*** because . . . frame rod construction makes crawl negligible . . . deflector protects spring and rods from escaping steam.
3. . . ***Maximum protection*** because . . . full opening is practically instantaneous . . . full rated nozzle capacity is available at popping pressure . . . once set under operating conditions, its popping point is constant.
4. . . ***Positive reseating*** because . . . floating disc design . . . steam-centered piston . . . permanently flat seats.

Specify the Foster 38-SV Super-Jet Safety Valve for the finest in high-pressure protection!

Complete details of the Foster 38-SV Super-Jet Safety Valve, for pressures up to 3000 pounds and temperatures up to 1200° F., are given in Bulletin 25. Write for it today!

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.

(or their equivalent) regularly or it can be used as an emergency "stand-by" power source. It can also be used to operate electric drills, grinders, saws, hammers, compressors, paint sprayers, and other electric motor-driven equipment.

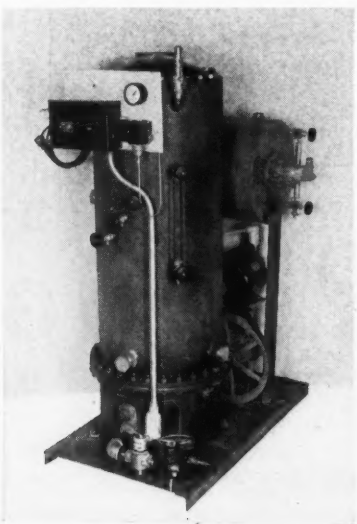
This development is compact and light in weight, due to the ingenious manner in which a single generator, powered by a single gasoline engine, is made to do all the useful jobs this unit will do. It is described as the first equipment that makes it possible to use alternating current for welding without being tied down to locations where power lines are accessible. And just as important are its advantages that enable the operator to weld and use power tools alternately from the same power source.

R Automatic Steam Boiler. The "Alert" Steam Boiler is described as completely automatic and is delivered to the user with all controls in place on the boiler ready for operation. This unit includes the condensate return system with motor, pump and tank with float valve in tank to add water made up as needed.

Also water feed control to maintain water level in boiler-pressure control including complete safety features. When delivered it is ready for service with all interconnected piping and wiring neatly finished by experts at the factory.

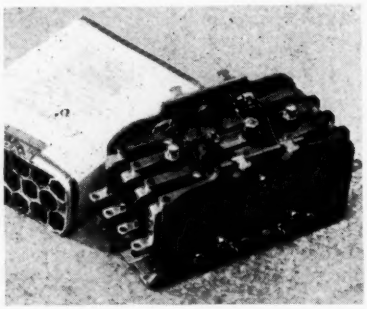
The entire unit with boiler and all controls, pump, piping and wiring is mounted on one substantial steel bedplate base and is very small and compact in floor space. When set in place it is only necessary to remove the boxing, make water, steam and fuel connections, then plug in the extension to the wall socket for current and it is ready to operate. The boiler is shipped with all parts in place as illustrated.

The boiler is built to ASME code requirements in several sizes ranging from 2 to 30 hp. Also made in nonautomatic or standard units. It is announced by Alert Engineering Products.



S 3-Position Relay. As an improved output device for relay-terminated control circuits and servomechanisms, Sigma Instruments, Inc., offers a new 3-position or null indicating polarized relay. This unit combines a high order of sensitivity and speed with a flexible contact structure of up to a maximum of four normally open circuits for each polarity (total of eight) having power handling capacity comparable with light to medium duty switching relays.

When the coil is provided with two



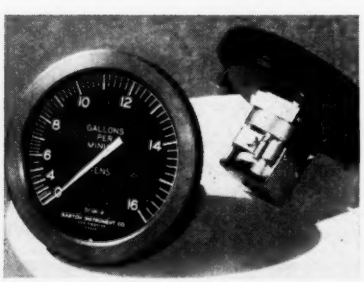
opposed windings for use in a push-pull cutout circuit, minimum differential power requirements are approximately 0.005 watt per contact pole, and operation is entirely unaffected by variations in "stand-by" current. With a single-wound coil, about 0.0025 watt is needed per contact pole.

The armature, which is almost exactly balanced, has "snap-action" centering or detent, and does not move gradually with increasing coil current. About 25 gram of force at the contacts are available from an input of 0.005 watt, and a similar amount for holding the central or null position, with input balanced or zero. The magnetic circuit being polarized, these forces increase directly with current up to nearly 200 grams.

High forces and balanced armature give this relay exceptional ability to withstand shock and vibration. Contacts, which may be ganged in double break or paralleled pair arrangement, are rated at 5 amp 110 v a-c.

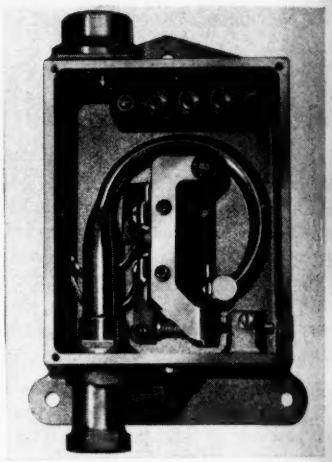
T Differential Pressure Indicator. The Barton Instrument Co. announces the new Model 181 Differential Pressure Indicator for the accurate measurement of flow, liquid level and pressure differentials.

The Model 181 features a six inch dial for easier visibility; wide differential pressure range (0-50 in. of water up to 0-200 psi); universal mounting and an improved vapor-proof case.



The Model 181 is constructed of drawn bar stock and has brass rupture-proof bellows. Static pressure ratings extend up to 300 psi. The size of the indicator is 7½ in. diameter, depth 4½ in.

U Pressure Operated Switch. This device has been widely used as a control mechanism in such fields as, chemical processing, petroleum, food processing, heating and air conditioning, pneumatic and hydraulic systems, machine tools, aircraft, etc. The Model 310 is one of Meletron Corp's. wide line of



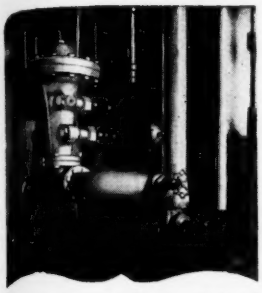
switches actuated by the pressure of liquids, air or gases.

These devices embody such special features as convenient adjustment, explosive-proof design for hazardous installations or construction which prohibits tampering, by the operator, with the pre-set operating characteristics.

V Inverted Pumps. These new pumps are an addition to the Aldrich Pump Co.'s line of Inverted Triplex and Quintuplex Pumps. With these additions the line now covers pumping units from 15 to 2400 hp. Rather than build enlarged versions of the Quintuplex for the larger hp range, standard Quintuplex parts were used to construct assemblies of more pumping elements—7 and 9, respectively, for the Septuplex and Nonuplex.

Due to the method of lubrication in these pumps, they are adaptable to higher speed than any previous design reciprocating pump. For this reason they may be engine type driven by a synchronous motor mounted directly on the pump crankshaft, or, in the larger sizes, direct coupled to engines having speeds from 225 rpm to 275 rpm. In sizes 800 hp or below, the pumps are designed to incorporate built-in gearing for direct coupling to pinion shaft for use with either high speed motor or engine drive.

Over 300 million pounds per hour

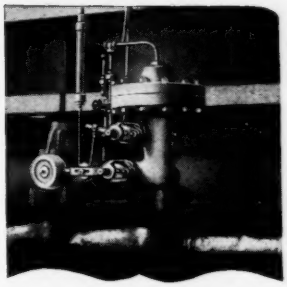


Canadian steel mill controls level in 150-psi Foster Wheeler boiler with a direct-operated Flowmatic

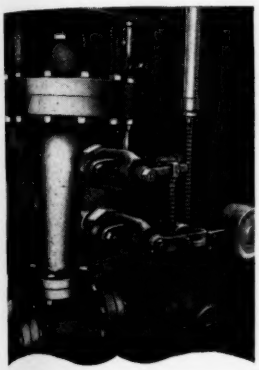
Add capacities of the 2000-plus boilers for which COPES Flowmatic Control has been ordered and they total more than 300,000,000 pounds of steam per hour. Individual boiler capacities run from 10,000 to 700,000 pounds per hour; pressures from 80 to 1825 psi.

This wide acceptance of the two-element COPES Flowmatic Boiler Feed Water Control results from the fact that all installations have one thing in common: Boiler water level is stabilized within remarkably close and safe limits, regardless of speed or severity of load fluctuations, while feed water input is geared to steam output for high operating efficiency.

Write us in detail about your operating conditions, and you'll receive helpful data.



Direct-operated Flowmatic controls level on this 410-psi Riley boiler carrying fluctuating loads



125-psi Union Iron Works boiler in food-processing plant is equipped with direct Flowmatic

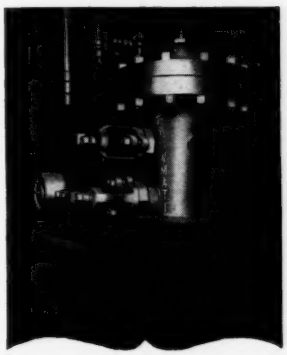
NORTHERN EQUIPMENT COMPANY

1072 GROVE DRIVE, ERIE, PENNSYLVANIA

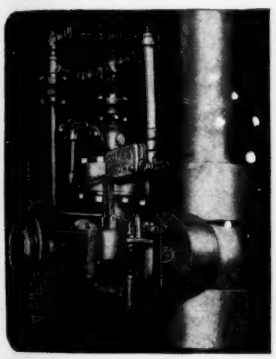
Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France, Austria

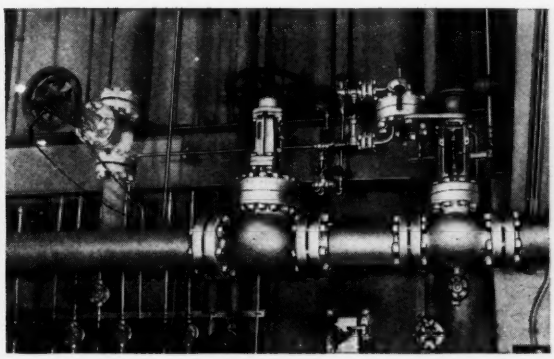
Representatives Everywhere



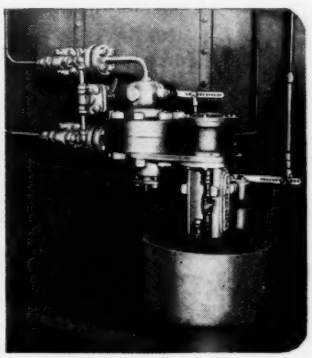
Southern municipal power plant has direct-operated Flowmatic on 420-psi B & W Stirling boiler



Vertical-line installation: Relay operated Flowmatic on 675-psi C-E unit in Eastern utility plant

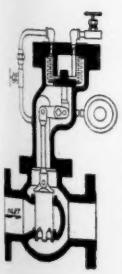


Relay Flowmatic controls level for 675-psi, 220,000 lb-per-hr Foster Wheeler unit in one of three stations of prominent utility system discussed in Bulletin 463



1265 psi, 275,000 lb per hr. Two C-E boilers in utility station are Flowmatic-equipped. Bulletin 465

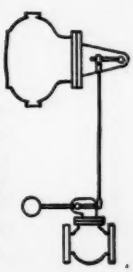
★ *Get Closer Level Control With The* COPES FLOWMATIC



DIFFERENTIAL VALVES

COPES Differential Valves maintain constant pressure drop across the feed water regulator valves, regardless of changes in pump pressure or line friction losses accompanying wide fluctuations in boiler load. Individually designed for each installation. Available in separate bodies, as illustrated, or in combination with the feed water regulator valve bodies.

LIQUID LEVEL CONTROL



For control of water or steam input or output, open or closed vessels. For throttling steam supply to fluid pumps. Semi-steel, cast-steel or forged-steel float chambers, with floats of different sizes and materials to meet individual needs. The direct- or relay-operated COPES Valves have low friction, high lift, accurate balance, ports designed for each installation.

Another MAINTENANCE *Record* for "GUN-PAKT" JOINTS!

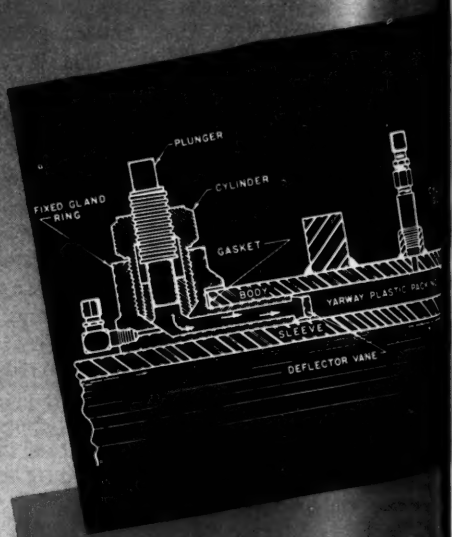
WESTERN UTILITY MAINTAINS
ALL YARWAY EXPANSION JOINTS
AT COST OF $1.50 PER MONTH FOR PACKING

Over the last 12 years this company has installed 121 Yarway Gun-Pakt Expansion Joints, ranging in size from 3" to 20". During that period they have had to purchase only 76 pounds of packing for these joints . . . at a cost of approximately $1.50 per month. That's to service *all* the Gun-Pakt joints!

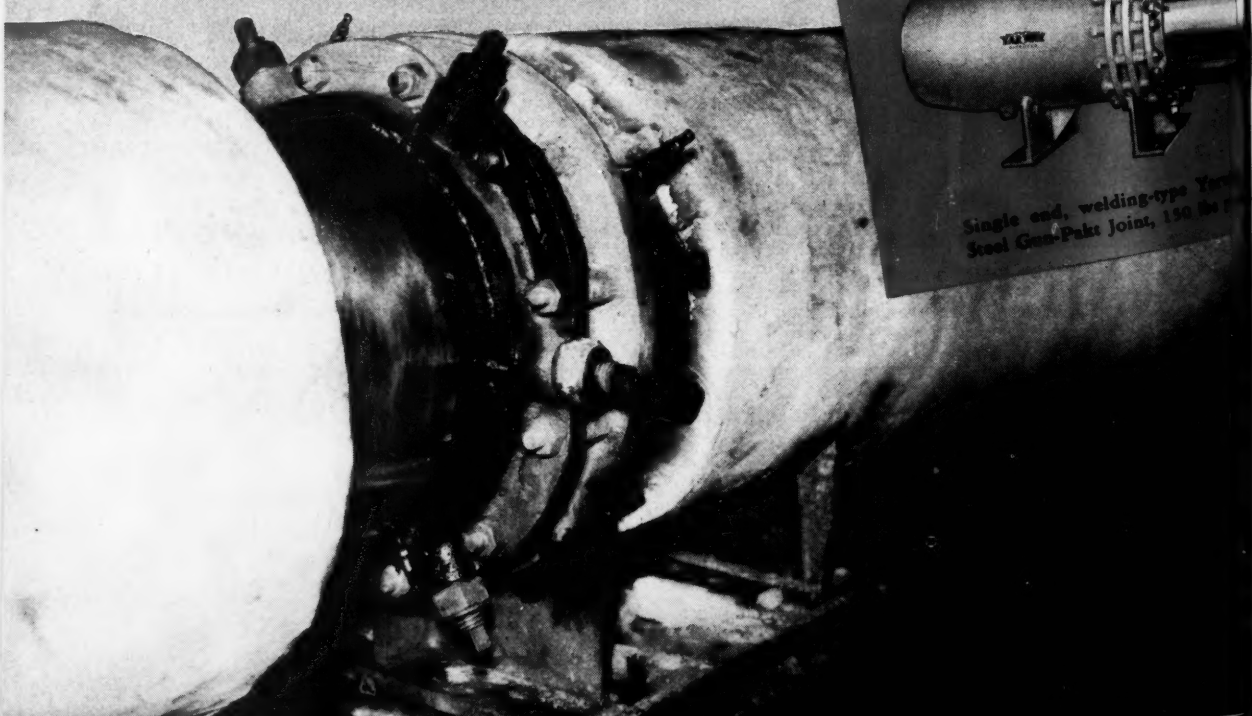
The Gun-Pakt feature is more than an idea—it is a practical improvement in expansion joint design that has saved thousands of dollars in operating and maintenance costs to public utilities and others who have installed them in steam distribution systems. With Gun-Pakt joints there is no need for costly shutdowns for repacking. *They can be serviced under full steam pressure.* Insert a packing plug . . . twist a wrench—the joint's tight, the job's done.

For the full story on Yarway Gun-Pakt Expansion Joints, write for Bulletin EJ-1911.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



Single end, welding-type Yarway Steel Gun-Pakt Joint, 150 lbs p



YARWAY GUN-PAKT EXPANSION JOINT

WHAT LEADERS SAY

What is the ANMB Doing?

By RICHARD R. DEUPREE

Harris & Ewing photo

THE ARMY AND NAVY Munitions Board is a joint board consisting of the Under Secretary of War, the Assistant Secretary of the Navy, and myself as the civilian Executive Chairman, with a staff of both officers and civilians detailed from the War and Navy Departments. Its primary responsibility is that of developing an industrial mobilization plan for use in the event of any possible future national emergency.

Experience has shown us the results of neglect and failure to prepare adequately in advance for modern war. This country entered the first World War with no coordinated plan for mobilizing industry and with totally inadequate plans for even procurement of munitions. All organizations, policies and control action had to be improvised which inevitably meant inefficiency, confusion, unequal distribution of war load, unnecessary civilian restrictions, disturbance of price levels, waste of national resources, and delay in getting war materials to the battlefront.

After World War I the United States, as well as other nations, made some efforts to correct gross errors and to prevent their recurrence, and although industrial mobilization plans were formulated, the latest revision thereof was not published until the year World War II began. Furthermore, when it became necessary to mobilize industry for American effort in the war these plans were not put into effect. Again initial preparation was marked by improvisation, trial and error, and organizations which were created and quickly or slowly reformed. The national safety was again jeopardized by inefficiency, confusion, waste and delay.

In World War II we survived the loss of time in preparation because we had the advantage of distance from our enemies and the steadfastness of our Allies to protect us until we were ready. In another war, which we all hope will never occur, the far-reaching and swift-striking power of new weapons will almost immediately endanger our productive capacity and could paralyze considerable of our effort. To avoid disaster, we must be able to utilize all our strength and to do so quickly without fumbling, error or second trial.

It is, therefore, the primary concern of the Army and Navy Munitions Board to prepare a judicious plan for industrial mobilization under which a state of readiness can be guaranteed at all times. We must know where the raw material is coming from, whether it originates in this country or in the rest of the world; we must make sure of facilities to process these products; and in some manner we must be able to more or less guarantee a flow of production of parts that go into the end product. We must make sure that there is a civilian organization to handle the situation and this means only one thing, men of industry and of the sciences. Charged with the protection of this national security, the armed forces are fully aware that they alone are powerless to carry out their responsibilities. Their part can be but the initiation of plans, the providing of strategy and tactics, the ordering of essential war products, and the actual combat. Almost all provision of war materials, all manufacturing processes, all emergency controls so essential to successful coordinated effort, must of necessity be in civilian hands when an emergency begins. Thus the plan for industrial mobilization is not an Army and Navy Munitions Board plan or an armed forces plan, but a plan by representatives of all Americans rather than the military alone.

Developing an industrial mobilization plan begins with a broad estimate on the part of the Joint Chiefs of Staff as to the quantity of materials and supplies which will be required by the armed forces in any given effort. Based upon that estimate it is the duty of this Board to survey the Nation's resources and facilities so as to determine the availability of the raw materials necessary for processing and the plant capacity needed to do that processing. We also must be very mindful of the timing of production. Merely for illustration, you will remember that it took fully two years to get into anything like quantity or mass production of airplanes, and two years is a long time when you are in trouble.

To avoid this, it is going to be necessary to have a flow of products, even a minor amount, actually going through the shop; it is going to be necessary to literally blueprint plants for increased production; it is going to be necessary to have certain standby tools in the airplane industry. I think we can figure reasonably accurately the amount of money this will cost and it does seem to me, if the country is wise, we will be willing to spend this money as insurance for quick production for needed weapons in case there is trouble. This must not only be done with airplanes but with other essential products and other essential raw material processing plants.

The next step in mobilization planning is to locate the facilities for converting raw materials into items such as airplanes, ships, guns, tanks, and ammunition and the very important

(Continued on page 79)

This report on the activities of the Army and Navy Munitions Board was delivered by Richard R. Deupree, executive chairman of the Board, at the All-Engineers' Dinner of the 1947 Midwest Power Conference in Chicago. It outlines for the engineering profession the general objectives and procedures of ANMB, so that engineers will be in a position to co-operate with it in working out an effective plan for industrial mobilization in time of emergency.

Mr. Deupree was appointed executive chairman of the Board by President Truman in February, 1946. He is president of the Procter & Gamble Co. He was born in 1885 in Virginia, received his education in the public schools of Covington, Kentucky, and began his career as clerk in the office of the Cincinnati & Covington Street Railway Co. in 1901, serving until 1908. Since then he has been continuously identified with the Procter & Gamble Co., where he began as a clerk and rose successively through the positions of general sales manager, general manager and vice president to his present post in 1930.

He is also chairman of the board of various Procter & Gamble subsidiaries such as Hewitt Soap Company, Inc., Thos. Hedley & Co., Ltd., and Buckey Cotton Oil Co. in England. He is a director of B & O Railroad Co., Coca Cola Co., and other organizations. He served on the War Production Board and was a member of a committee named by General Somervell to visit the European theater of war.

He has been active in Community Chest and other civic activities in Cincinnati, is trustee of the Cincinnati Institute of Fine Arts. He is a member of the visiting committee, Harvard Business School; member of the Business Advisory Council, U. S. Department of Commerce and member Board of Trustees, National Safety Council.

Power for Detroit Sulphite Pulp & Paper Co.

New power plant built during the war provides all steam, water and electric power needed in the plant of the Detroit Sulphite Pulp & Paper Co. at Detroit . . . Plant located on the River Rouge, a tributary of the Detroit River . . . Old boilers replaced by two new 110,000 lb per hr, 600 psi boilers furnishes steam to a new 4000 kw "topping" turbine . . . Boilers fired by water-cooled underfeed stokers . . . Topping turbine exhausts at 150 psi to two existing 2500 kw turbogenerators . . . Two refuse burning boilers on 150 psi line burn bark containing 65 per cent moisture

TO MAKE A PROFIT, a paper mill in the Detroit metropolitan area has to be efficient. Compared to paper mills in more remote places, labor costs and taxes around Detroit are very high, and to make a good showing, a plant must not only be well designed but well operated. This applies with particular emphasis to the power plant where the steam, electricity and hot water used in the mill is produced. An inefficient power plant can make a great difference in the overall cost of the product.

The fact that the Detroit Sulphite Pulp and Paper Co. does make a good showing is ample testimony to its efficiency. This company makes bleached and unbleached (Mitschfibre) sulphite fiber, and a variety of papers ranging from tissue to light board.

Located on the River Rouge in Detroit, the plant receives practically all of its wood from Canada by boat. Coal for the power plant is delivered also by boat.

Until the early years of the war, power was produced in an old plant consisting of twelve low pressure boilers, serving two 2500 kw turbogenerators with jet-condensers and arranged to bleed steam at 28 psi.

With increasing loads imposed by the war it became necessary to enlarge the power plant and at the same time to replace the old boilers with modern units. The old boilers had been in service for many years and were approaching the end of their useful life.

Accordingly, plans were made for a new plant. Gibbs and Hill, Inc., consulting engineers of New York, were retained to make studies and to design a new power plant. Construction, however, was carried out by the company's own engineering department under the direction of E. Gschwender, plant engineer and his assistant, M. F. Schnaufer.

The new plant was built on the site of the old one, in fact, as much as possible of the old building was retained, though the new boilers are essentially in a new building. This made necessary the continued operation of the old boilers while the new plant was being built. This complicated the work, but it was carried out successfully with no unusual difficulty. After several old boilers were removed, a new one was installed and when this was ready to go on the line, the other old units were removed to make room for the second new unit. To provide head room for the new boilers, the height of the boiler house was increased.

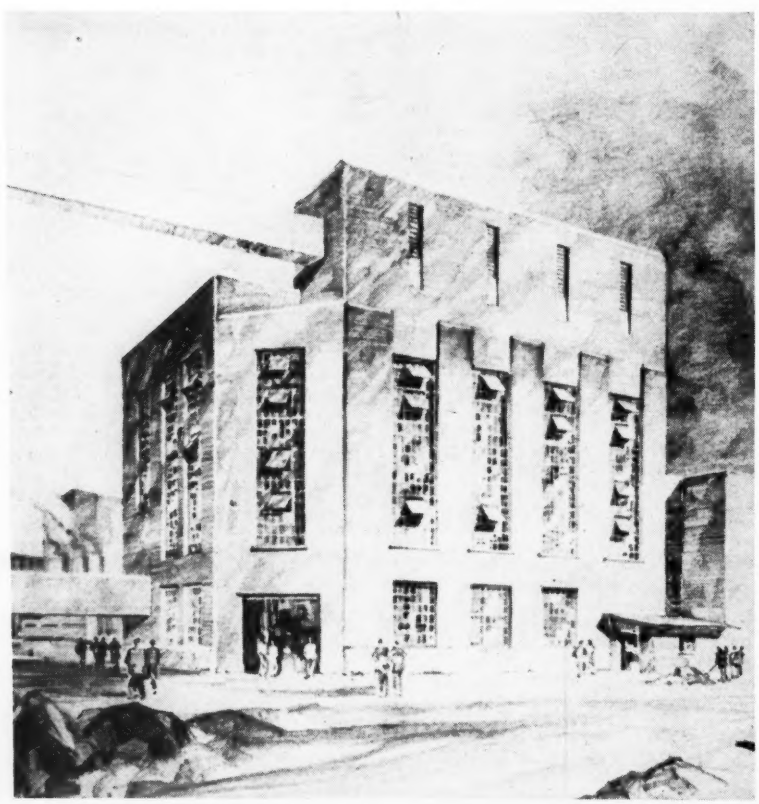


Fig. 1. Architect's drawing of the new Detroit Sulphite Pulp & Paper Co. plant

The New Plant

The new equipment in the plant consisted of two, Babcock & Wilcox, 2-drum, bent tube boilers with water-cooled wall construction, rated at 110,000 lb per hr each, operating at 600 psig, 750 F. Each boiler is equipped with a plate-type air heater and a tubular economizer. They are fired by Taylor water-cooled stokers, steam driven and furnished by the American Engineering Co.

Each boiler has its own forced and induced draft fans but both boilers are served by a single stack. Both induced draft and forced draft fans are American Blower Corporation "Sirocco" units, driven by Terry turbines.

Operating at 600 psi, these two boilers deliver steam to a new 4000 kw non-condensing Allis-Chalmers turbine-generator unit. This unit exhausts at 150 psi, 500 F into a header connected to the old 2500 kw turbo-

generator. While these old units operate condensing, they are arranged for extraction at 28 psi. The 28 psi extraction steam is used in the mill and also to heat the boiler feedwater.

Thus there are two "process" steam lines to the mill, one 150 psi line and the 28 psi line. The 150 psi line, of course, was the main steam header in the old plant being fed directly from the oil boilers. Four of these old units are still in the plant, two 250 hp coal fired units for emergency use only and two 300 hp units arranged to burn bark. While the bark is removed from most of the logs at the source in Canada, a limited amount is available at the plant and this is burned under these old 300 hp boilers. These units are operated 16 hr a day, being banked the remaining 8 hr. Since the bark has a moisture content of around 65 per cent, it is too wet to sustain combustion alone; hence it is burned in combination with coal.

A bypass, consisting of a reducing valve and desuperheater is provided, across the 4000 kw, "topping" turbine, to furnish additional 150 psi steam, in case the mill requires it. This bypass is used as little as possible, however, and normally all 150 psi steam is derived either from the 4000 kw turbine and the refuse (bark) burning boilers.

As indicated on the flow diagram all forced and induced draft fans as well as one of the boiler feed pumps are supplied from the 150 psi line—their auxiliaries all being steam driven. Two motor driven and one steam driven Ingersol-Rand feed pump are provided. All of these steam-driven auxiliaries exhaust into the 28 psi line.

All water, for use in both the paper mill and the boiler plant, is pumped from the River Rouge. For use in the mill, the water is filtered and treated. That used for boiler feedwater, however, is treated separately in the Cochrane hot process softener, using soda ash. Phosphate also is used, this being fed directly into the boiler. The boiler feed pumps are supplied directly from the Cochrane Softener.

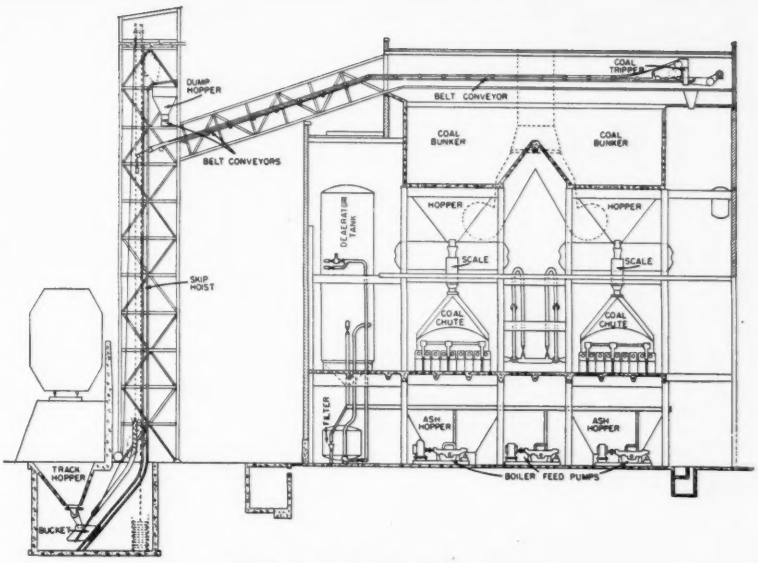


Fig. 3. Front elevation of the plant

As indicated on the flow diagram, there is also a connection of the feed pump suction line to the old deaerator from which the old boiler feed pumps were supplied. Ultimately a slightly different piping arrangement is planned.

Physical Arrangement

The layout of the plant is simple. Coal is delivered by ship as shown in Fig. 2, into a track hopper from which it is carried by an automatic skip hoist and belt conveyors to the overhead coal bunkers. The skip hoist and conveyor were furnished by Bartlett and Snow. From the bunkers, the coal flows by gravity through dust proof scales and conical distributor chutes (Stock Engineering Co.) to the stoker hoppers. The ash is dumped into an ash dump car propeled by an electric locomotive and discharged into a skip hoist to an ash hopper.

It will be noted that the boiler operating floor is on a level above the turbine operating floor. This arrangement was dictated by existing building conditions at the time the new installation was made.

The boiler feed pumps are located on the ground floor, as are the turbogenerators. Both the forced and induced draft fans are mounted above and at the rear of the boilers as shown. The tubular economizers are mounted above the flue outlet of the boilers. After passing through the economizers, the gases make a 180 deg turn downward into the air heaters, from which they are drawn by the induced draft fans and delivered to the stack which is common to both boilers.

Combustion is controlled by the Bailey Meter Co., system and feed water regulation is by Copes-Northern Equipment Co. regulators. Diamond Power Specialty soot blowers are installed on the boilers. The hot process Cochrane softener is located at one end of the boiler room as shown in Fig. 2. Other arrangements and features are apparent from the accompanying illustrations.

The arrangement as a whole provides an efficient and flexible layout, capable of meeting the varying demands of a paper mill with dispatch and ease. The plant generates all the electric power used in the mill and, of course, supplies all the steam and hot water.

For those not particularly familiar with the details of sulphite paper making, Fig. 6 may be of interest. This shows the complete process. In

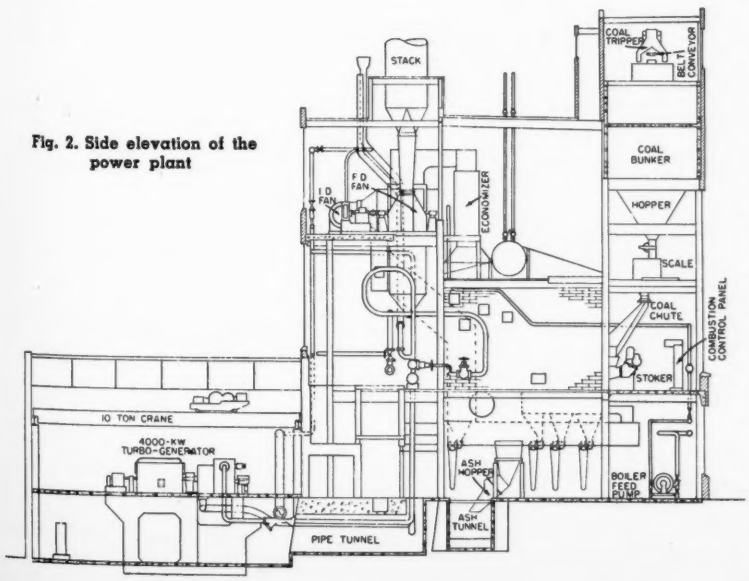


Fig. 2. Side elevation of the power plant

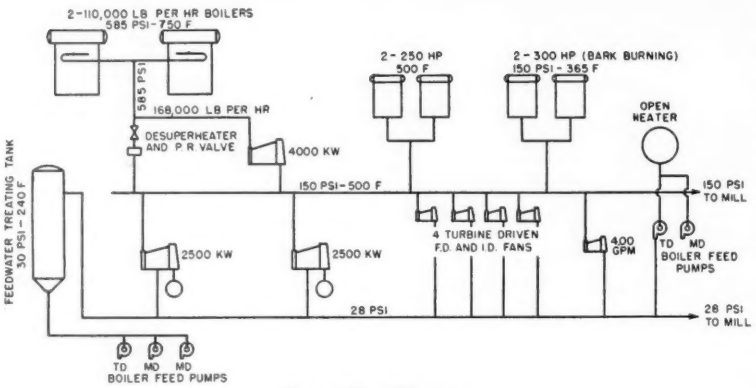


Fig. 4. Flow Diagram

the wood room, the wood tumbles through a revolving drum which washes it. Clean wood is cut to chips of uniform size and delivered to the digesters. Here acid is introduced. This comes from the acid plant as shown. In the acid plant, pure sulphur is burned. The sulphur dioxide gas formed is cooled and blown into a tower filled with limestone over whihc water trickles. Gas plus water forms acid, consumes the stone, and makes the calcium bisulphite solution used in the digesters.

In the digesters, lined with acid-proof brick, the wood chips are cooked in the acid liquor under strict schedules of pressure and temperature. Wood is only half cellulose fibers. The other half dissolves in the acid and is washed away in the drainer pits beneath the digesters, leaving pulp (separated fibers) behind.

Mixed with much water, the fibers pass through louvers. Unscreened fibers are used to make screened pulp. Clean, accepted stock is dewatered by means of cylindrical drums, and bleached with chlorine lime water. For shipment or storage pulp is pressed into wet laps.

If intended for paper, the slush and paper stock is pumped to the beaters where the fibers are prepared to suit the grade of paper made on the paper machine. Wet laps, soon become slush and this is delivered to the "Jordans" (continuous beaters). Here it is greatly diluted, screened again and put on the paper forming surfaces of several different types of paper making machines as indicated on the diagram.

As will be obvious, large quantities of steam and water are required in the process, as well as electric power for driving the machines. Hence, the power plant of a paper mill constitutes a very important element in the whole scheme of things, and as pointed out at the beginning of this article, the cost of power is a vital element in the final cost of the paper.

The amount of steam produced annually is 1,064,190,039 lb, the electrical energy, 32,465,000 kwh.

The power plant at the Detroit Sulphite Pulp and Paper Co. is under the general supervision of E. Gschwender, Plant Engineer, and he was largely responsible for its construction. As already mentioned, Gibbs and Hill, Inc. of New York were the consulting engineers. Credit is extended to both Mr. Gschwender and John H. Hochuli of Gibbs and Hill, Inc. for assistance in the preparation of this description. The drawings were furnished by Gibbs and Hill.

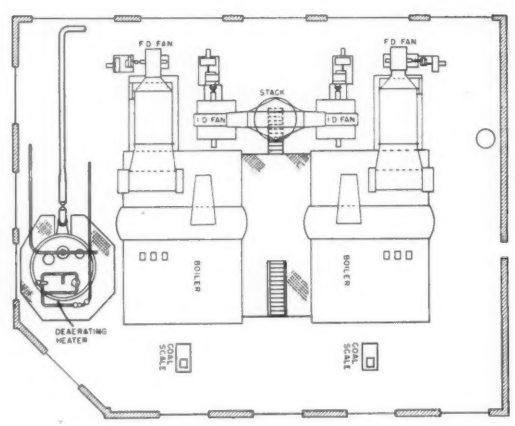


Fig. 5. Plan at the forced and induced draft fan level

Fig. 6. Diagram showing the sulphite paper process

TRANSFORMER FOR BONNEVILLE

THE HIGHEST rated single-phase transformer ever built by Westinghouse will soon be installed at the new $2,700,000 Snohomish Substation of the Bonneville Power Administration near Everett, Washington. One of four being constructed at the Westinghouse plant at Sharon, Pennsylvania, these transformers will be operated at 230 kv and will have tap-changing-under-load equipment.

The transformers have three ratings depending on the method of cooling used. Self-cooled, each can deliver 50,000 kva. When forced-air cooling is used, the capacity of each transformer increases to 66,667 kva and top output becomes 83,333 kva when the oil is circulated by pumps. Three of them will be operated as a bank with ratings of 150,000, 200,000 and 250,000 kva depending upon the method of cooling used.

New Overcurrent Tripping Device for Low-Voltage Circuit Breakers

Review of delay elements used in overcurrent trips . . . Requirements for delayed tripping devices . . . Description of the new overcurrent trip . . . Characteristics of new trip . . . Application of characteristic to circuit breakers . . . Test results

By H. L. RAWLINS and JEROME SANDIN, *Westinghouse Electric Corporation, East Pittsburgh, Pa.*

THE TRIPPING requirements for low voltage circuit breakers have until recently been satisfied by a self-contained series device that provided sufficient delay on overcurrent tripping for the immediate load at hand and which became instantaneous at rather low values of fault current. This characteristic was sufficient to provide for some breaker selectivity on the lower values of fault current. Where complete breaker selectivity has been required, it was accomplished through relays in the same manner as with high voltage breakers. With increased concentrations of power, the necessity for selective tripping of low voltage breakers throughout a greater range of fault currents has become apparent. It is also recognized that relays and accompanying current transformers are undesirable in most installations from the standpoint of complexity and cost.

The selective tripping of these breakers can be accomplished by the addition of definite short time delay tripping devices that are effective throughout the required range of fault currents. This has been done in some instances and complete selectivity has been accomplished. The accomplishment of selectivity in these instances has required considerable engineering study and skill, and it has become evident that an improved type of delayed trip is needed to simplify the application of low voltage breakers.

The reliability and usefulness of a delayed overcurrent trip device depends mainly upon the characteristics of the delay element. The delay elements in general use are:

(1) Liquid Film Delay. In this device the delay is obtained by the adhesion of liquid to two operating surfaces. While it has been popular it has certain limitations. Its timing is not accurate and its successful operation depends upon local conditions of temperature, humidity, etc.

(2) Thermal Delay. Thermal delays while useful on low currents cannot be used to provide a delay at high values of fault current. Also, it is relatively complicated when used on higher rated breakers and is not suitable for use on higher rated breakers.

(3) Dashpot Delay. This involves the actual displacement of liquid in a cylinder. These are not in general use at present for low voltage breakers but are used with transformer trip devices on high voltage breakers. Dust and dirt can affect their operation though this limitation can be obviated by certain designs.

(4) Mechanical Delay. Delays involving escapement mechanisms, air vanes, or inertia devices connected through gearing to series magnets have been in common use in foreign countries but have not been in this country until recently where they have been used in simple form for obtaining the short time delays necessary for breaker operation. They require accurate workmanship, however, and because an appreciable part of the driving effort is used to overcome friction, they are subject to variations in pickup. They may become inoperative under adverse conditions of corrosion.

The necessity for greater service continuity on low voltage systems has focused attention on the limitations of present delayed overcurrent tripping devices and created a demand for their improvement. This abstract of a paper presented by the authors before the AIEE summer meeting at Montreal in June of this year reviews the limitations of present devices and states the requirements for delayed overcurrent trips. A new device meeting all of the requirements is described and its characteristics shown. The new device is universal in its application in that the same elements provide for breaker selectivity up to the highest values of fault current and yet give correct timing to permit motor starting. Tests are described which show the adequacy of the new device for its intended service in modern industry

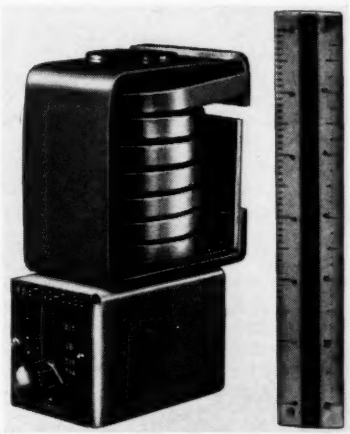


Fig. 1. New trip unit. 225 amp rating

Requirements for Delayed Tripping Devices

The requirements for a satisfactory delayed tripping device are as follows:

(1) Sufficient delay must be provided throughout the range of motor starting currents to permit starting of motors having the highest values of locked rotor currents.

(2) Above locked rotor currents, the device should be capable of providing the shortest permissible delay necessary for selectivity.

(3) In order to provide the maximum possible protection to associated equipment and to other breakers when connected in cascade, the device should be capable of tripping instantaneously at any fault current up to the short time rating of the breaker.

(4) There should be a wide range of pick-up adjustment on the delay element.

(5) The device should be suitable for both a-c and d-c breakers.

(6) The trip unit should be easily removable and interchangeable to facilitate changes in breaker ratings and characteristics.

(7) The device should be reliable

and maintain its reliability without maintenance under all types of service conditions.

The New Overcurrent Tripping Device

The device incorporating all of the required features is shown in Fig. 1. This unit is arranged to be readily removable so that interchangeability of trip units having various ratings and characteristics can be obtained. The unit shown has a 225 amp coil rating and is suitable for both 225 and 600 amp frame size breakers. For a clear understanding of the theory and operation of this new device, reference should be made to Fig. 2 which shows a sectional view of the new unit in the normal position. The elements of this trip unit are:

(1) the magnetic frame

(2) the series coil

(3) the sealed timing element incorporating upper and lower cores suitably restrained by a reset spring, the timing stem which determines the time characteristics, and the controlling fluid

(4) the instantaneous armature which provides instantaneous tripping above prescribed currents independent of any action within the sealed unit

(5) calibration details for setting the minimum pick-up of the unit

Pick-up occurs when the attraction of the cores exceeds the restraining force exerted by the weight of the sealed unit and the calibration spring. Delay is obtained by positive displacement of the fluid which is forced through the space between the upper core and the timing stem. The timing stem is the only variable in the sealed unit, and its diameter determines the size of annular orifice and, therefore, the time characteristics.

In operation, the upper core is held stationary due to the attraction of its upper surface to the annular edge of the magnetic frame while the attraction between the upper core and the lower core raises all parts of the sealed unit except the upper core. This action, shown in Fig. 3, raises the trip bar to unlatch the breaker. The anchoring of the sealed upper core in space relative to the stationary frame while subjected to very strong forces and with surrounding parts in motion was the major problem in this development, and its solution made possible the new tripping device. Successful operation requires that the force of attraction of the upper core to the magnetic frame exceed all forces restraining the movement of the sealed unit. These forces are the trip load required to unlatch the breaker, the weight of the moving elements, the pull of the calibration spring in its maximum position, and the inertia forces of the moving masses. Strong upward pull on the upper core is obtained by increasing the flux density on the top surface of the core through suitable shaping of magnetic parts, the use of a small air gap, and through the use of tapered conical surfaces between the upper and lower cores. This permits an increased amount of flux to flow through the upper and lower cores which although not adding appreciably to the pull between them does increase the flux density between the upper core and the magnetic frame. The calibration or settings for minimum pick-up is obtained by applying a suitable restraining force on the moving element. The toggle arrangement used to apply spring load to the moving element permits wide variations in pick-up settings.

The instantaneous armature provides for instantaneous tripping of the breaker irrespective of any action within the sealed timing element. On currents above the prescribed value, the instantaneous armature is picked up by the flux inside of the lower core, after it has saturated, and bodily raises the whole sealed element. This action, shown in Fig. 4, can be obtained for any value of current by adjusting the position or by varying the cross sectional area of the instantaneous armature. Since this armature is within the field of a solenoid, it will have a force exerted on it dependent upon the series current through the coil. This permits pick-up adjustments for the instantaneous armature at all values of current. This would not be the case if it were a clapper type of armature where saturation would limit the forces at higher currents.

Since fluid pressure in the sealed chamber is dependent upon the series current, it is possible to provide long time delays for currents up to predetermined values and, by the operation of a by-pass relief valve, to provide short time delay for higher currents. This by-pass valve may be incorporated in the timing stem as shown in Fig. 5. The stem with the valve as shown in 5(b) is merely substituted for the simple stem shown in 5(a). The operation of the by-pass valve is simple in that above a certain pressure the valve spring is compressed permitting the fluid to flow through a much larger orifice than the annular orifice on the outside of the timing stem which provides for long time delay.

The reset spring serves to position the upper core in the normal position and to reset the core after its movement during overcurrent conditions. The resulting delay on resetting makes the trip unit historic, that is, it remembers the previous electrical history of the circuit in which it is connected. The only advantage of the thermal trip over previous devices providing the same delay is that the thermal device is historic due to its storage of heat. This new device may be given a better or worse memory than a thermal trip by making the reset spring weak or strong.

The fluid used to obtain timing is an important factor in this new trip unit. Silicone fluid is used due to its stability at higher temperatures and to its smaller changes in viscosity with varying ambient temperatures.

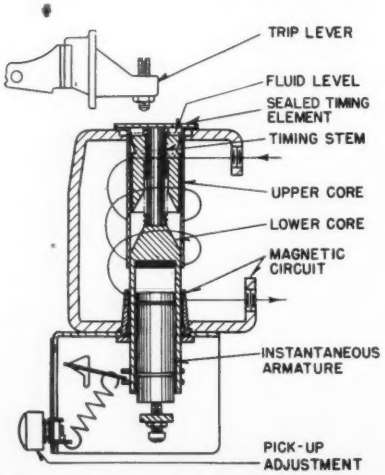


Fig. 2. Sectional view of new unit in normal position

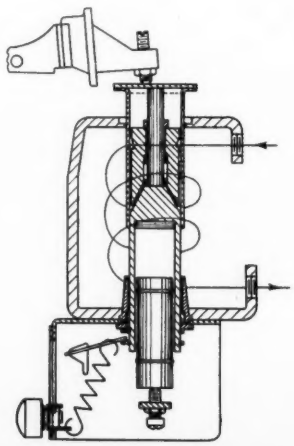


Fig. 3. Position of parts when tripping with time delay

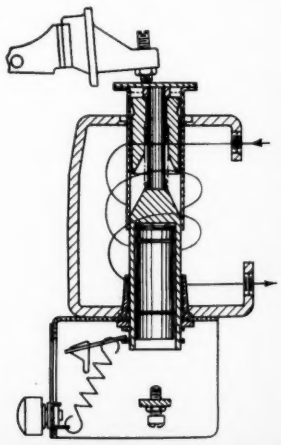


Fig. 4. Position when tripping through instantaneous armature

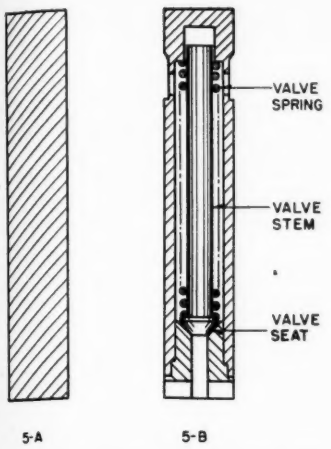


Fig. 5. Timing stems used to obtain different timing characteristics. A—Simple stem for single delay curve. B—By-pass stem for obtaining combined long and short time delay

A fluid of high viscosity is used since it permits more clearance of moving parts and larger orifices which result in smaller changes in characteristics with manufacturing variations. The tube and top disc are made of non-magnetic stainless steel due to its high resistivity, sturdiness, and resistance to corrosion. The cores are made of special silicon iron to reduce eddy currents and losses on alternating currents. On sealing, moisture and oxygen are removed from the fluid and internal parts by heat and vacuum treatment, which insures freedom from corrosion for the sealed parts. The final sealing of the timing element is very effectively performed by spot welding the disc to the flanged top of the tube. This operation, performed in a fraction of a second, in no way injures the liquid or internal parts.

Characteristics

Tests on the new trip unit have revealed that any desired time current characteristic can be obtained by varying the timing stem. A discussion of characteristics, therefore, does not consist of presenting some fixed curves but is a question of "what will you have". Figure 6 shows three time curves that can be obtained through the use of three different timing stems and represent desirable characteristics. Curve A provides sufficient delay for motor starting with the instantaneous trip operating at A to provide rapid clearing of all fault currents above locked rotor values. Curve B provides a short time delay for all values of fault current and can be used to obtain complete selectivity between breakers. Curve C is a combination of curve A and curve B and is obtained by the use of a by-pass relief valve in the timing stem. This characteristic would be used where selectivity is required between a breaker used for motor starting service and a backup breaker of approximately double its rating. There is a slight but definite slope to the transition from one curve to the other. This is due to the increase in attractive force between the two cores as they approach each other resulting in valve operation after partial travel.

In applying these characteristics to breakers, it is, of course, necessary to maintain certain ratios of ratings to assure selective operation. In the usual application, the ratios are almost always more than sufficient due to other factors. Figure 7 shows the curves for a typical selectivity application using the three characteristics previously described. Here a 100 amp load breaker is provided with long time delay and instantaneous trip to permit motor starting. A 400 amp feeder breaker is equipped with both long time and short time delay to obtain complete selectivity with the motor starting load breaker. A 1600 amp transformer breaker supplying power to the system is set to pick-up at 3000 amp and is equipped with short time delay only since that will provide for selectivity with the 400 amp feeder breaker and all other feeder breakers. If the transformer can deliver more than 25,000 amp and the interrupting rating of the load and feeder breakers is 25,000 amp, the system should be operated with combined cascade and selectivity by providing the feeder breaker and the transformer breaker with instantaneous trip armatures set at 20,000

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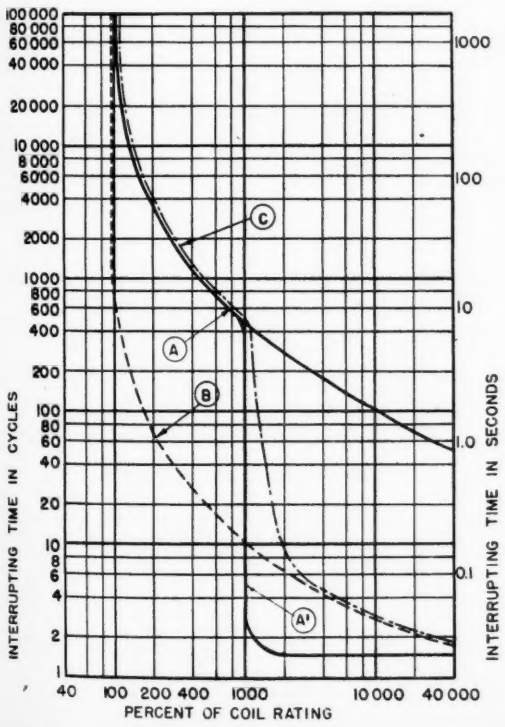

Fig. 6. Typical time current characteristic curves of the new trip

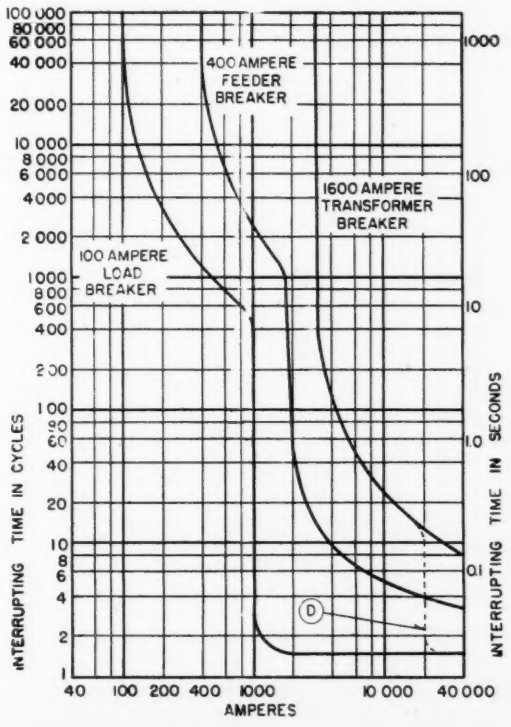

Fig. 7. Time characteristics of circuit breakers equipped with the new type trip units for selective operation

Corrosion in Boiler Feedwater Treating Systems—I

By LEO F. COLLINS *Chemical Engineer, The Detroit Edison Co.*

TIME WAS when the periodic slugging of boilers with proprietary chemicals constituted the acknowledged standard of water conditioning for steam generating purposes. Troubles not so corrected were looked upon as inevitable, but in most cases were of limited consequences because of the low pressures, temperatures, and steaming rates employed.

Since that time, the advantages inherent in the utilization of high heat transfer rates and in the use of uncontaminated steam have been conclusively demonstrated. And, it has been shown, too, that if these technological advances are to be employed successfully, the boiler feedwater must be conditioned more in detail than can be achieved through the promiscuous feeding of "compounds" of uncertain composition.

To meet these more exacting demands, *methods* of feed water treatment have been devised that are essentially *chemically processing systems*. Therein substances are added and/or removed step by step as the water proceeds through the processing equipment en route to the boilers. Such systems are indispensable to operation. Even so, prolonged operation sometimes discloses "weaknesses" within the processing system itself that are the source of considerable annoyance to plant operators.

Many systems of the type under discussion employ zeolites, acids, and degasification. In these, corrosion is perhaps the most universal cause of operating annoyances. While such troubles are seldom of major consequence, considering the over-all advantages ensuing from such systems, it would benefit both designers and operators if such "limitations" could be minimized in the original design of the system. This paper attempts to supply criteria leading to such improvements. It presents the results of studies and observations covering twelve different systems, plus experimental data from complementary research work.

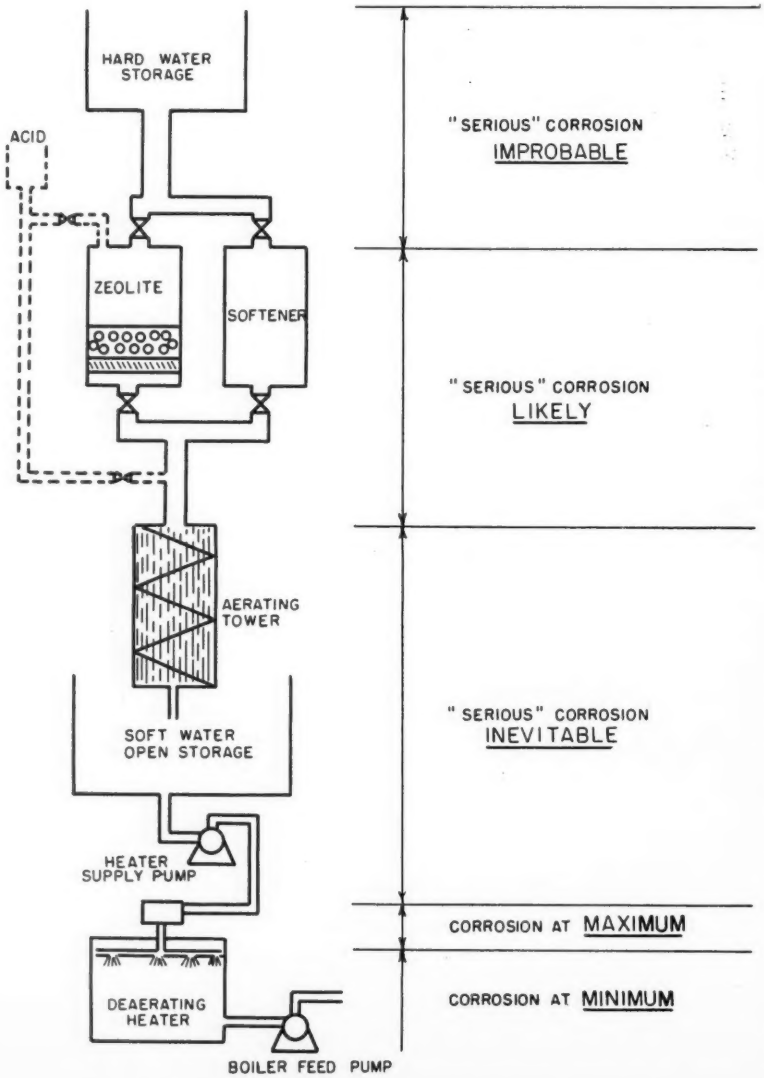

Diagram of a typical zeolite-acid-degasification feedwater treating system

The Corrosion Pattern

There are few data in the published literature attesting the "life" of materials in zeolite-acid-degasification boiler feedwater treating systems. Many well informed engineers ascribe this want not so much to a lack of research, but rather to the "impossibility" of gathering conclusive evidence. To substantiate this condition, it is usually postulated:

1. That the corrosivity* of waters varies so widely that data obtained at one location are unlikely to hold true elsewhere.
2. That no simple means exist by which the corrosivity of a water may be approximated.
3. That measuring the corrosivity of a water is so complex an undertaking as to be warranted only in special cases.

*Corrosivity is defined as the capacity of an environment to bring about destruction of a metal by the process of corrosion.

Refers especially to systems employing zeolites, acids and degasification . . . Indispensable to boiler operation, water treatment systems may have weaknesses causing operating annoyances . . . Why improvements are needed . . . This is first of several articles designed to supply data leading to better design and operation . . . They present results of studies on twelve different systems . . . This first article shows the pattern followed by corrosion in systems of this type . . . Corrosivity of water increases progressively in such systems, reaches maximum at deaerator vent condenser, decreases thereafter and reaches minimum at heater outlet or where pH of gas-free water is increased by addition of alkali . . . Maintenance and outages resulting from inadequately conditioned water are part of operation cost . . . Maintenance of water treating equipment not always at its best, hence limitations caused by corrosion may not be corrected at right time . . . Well-engineered water treatment system should contain materials to minimize maintenance, prevent failure during normal life of plant. . . Articles to follow will cover graphitic corrosion of cast iron, performance of materials in systems scheduled, performance of metals in handling chemicals, test results

When the work reported here was programmed, it was decided that the first step should be to collect such data as would substantiate or refute these postulates. To this end, the major features of design common to such systems were cataloged and studied; analytical data were assembled from four systems whose design differences were felt to represent most of the possibilities in this regard; and measurements were made in two systems that are the largest and oldest still in use.

Common Characteristics Considered

In an attempt to visualize the common characteristics of design that theory indicates will control corrosion, a "typical" system was diagramed as shown. The notations in the right margin were then added in deference to the following reasoning:

1. In all such systems, the entering water is **always hard.** As a result, the probabilities are that a tendency exists to form a film on the metal surface (a $CaCo_3$ deposit) that acts protectively.

2. In softening the water, the tendency to form a protective film is **always** eliminated. Otner conditions being fixed, this should **increase** the corrosivity of the water as compared with the influent.

3. When acid is added, the pH of the water will be lowered proportionately. Other conditions being fixed, this will also **increase** the corrosivity of the water.

4. In an aerating tower, a drastic reduction in "free CO_2" may be effected (with a proportionate increase in the pH of the water), but the water will certainly become saturated with air and its temperature is likely to be increased as a result of contact with the air. It is possible that the temperature increase (and possibly the increase in dissolved O_2) will more than compensate for the loss of CO_2, Presumably therefore, the corrosivity of the water is further **increased.**

En route to the feedwater heater, hot condensate is very often mixed with treated water. In the vent condenser of properly operated deaerators, the temperature of the water is **always** increased sharply under conditions that prohibit the escape of gases that otherwise would be purged from the water. Such conditions most certainly will **increase** the corrosivity of the water.

6. In passing through a deaerator, virtually **all** deleterious gases are removed. Thus a sharp decrease in the corrosivity of the water must be expected.

Upon the basis of these observations, it was concluded that one generalization might be drawn: The corrosivity of the water increases progressivly as the water passes through such systems and reaches a maximum in the effluent lines of the vent condensers of the deaerators; thereafter it decreases and reaches a minmum at the heater outlet or at that point where the pH of the gas-free water is increased, as by the addition of an alkali.

The four systems from which data (indicated by theory to be the principal corrosion controlling factors) were collected differed from one an-

Table I. Summary of corrosion controlling factors at four different plants

	O_2 ppm	pH Value	CO_2 ppm	C.H. ppm[10]	Temp. Deg. F
PLANT I					
A—Raw water[1]	11	7.4	2	82	50
B—Softened water	11	7.6	2	Trace	50
C—"B" following acid addition and aeration[2]	9	6.2	10	Trace	60
D—"C" after deaeration	0.04	8.5	0	Trace	215
PLANT II					
A—Raw water[3]	2	7.6	4	70	50
B—Softened water	4	7.6	4	Trace	50
C—"B" after acid addition and aeration[4]	4	5.6	10	Trace	150
D—"C" after deaeration	0.12	8.5	0	Trace	220
PLANT III					
A—Raw water	11	7.6	0	100	50
B—Filtered water after acid addition[5]	11	7.0	4	23	50
C—"B" after zeolite softening[6]	6	7.0	4	Trace	100
D—"C" after deaeration	0.40	8.0	0	Trace	215
PLANT IV					
A—Raw water[7]	11	7.8	8	80	50
B—Softened water	9	7.7	8	Trace	60
C—"B" after acid addition and aeration[8]	6	7.0	4	Trace	100
D—"C" after deaeration[9]	0	8.5	0	Trace	220

[1]From municipal supply.
[2]Containing also returned condensate.
[3]Private wells.
[4]Contains also about 75% condensate at about 200 deg. F.
[5]River water after Spaulding precipitator and acid addition.
[6]Contains also about 50% returned condensate.
[7]From lagoon after coagulation and filtration.
[8]Contains about 50% returned condensate.
[9]Oxygen fixation chemicals fed after deaerator.
[10]Carbonate hardness as $CaCO_3$.

THE AUTHOR

Leo F. Collins, holder of three academic degrees in chemical engineering, has had over 20 years of experience in the conditioning of water for power plant use. By a unique set of circumstances, this experience has embraced a variety of industrial plants and those serving large institutional building groups, as well as utility plants. He is the author of a generous number of technical articles. Readers of POWER PLANT ENGINEERING will remember his latest contribution, entitled Engineering Problems of Water Treatment appearing in the July, 1946, issue.

He is a member of the American Chemical Society; of the Committee on Water for Industrial Uses of the American Society for Testing Materials; is Chairman of the Chemistry Committee of the National District Heating Association; and of the Technical Advisory Committee on Corrosion of the American Society of Heating and Ventilating Engineers.

Table II. Indexes of corrosivity determined in two systems

TYPES OF WATER INVOLVED	Measured Value[1]	Langelier's Index	Measured Value[2]	Langelier's Index
	PLANT V		PLANT I	
A—Hard water (municipal supply)	2	—1.0	4	—1.0
B—Zeolite softened water	18	—1.6	14	—1.6
C—Soft water after acid addition and aeration	29	—4.1	29	—4.3
D—Same as C but deaerated	3	—0.4	8	—0.4

[1]Bessemer Steel Wire Specimens-values are inches penetration per year × 1000.
[2]Gray Cast Iron Test Bars-values are inches penetration per year × 1000.

other in the following important ways, as shown in Table I:

1. At Plant I, the raw water is obtained from a municipal supply of constant quality. **Dilute** acid is proportioned following the zeolite softeners, i.e., just preceding the aerating tower.

2. At Plant II, the raw water is obtained from a number of private wells. Its chemical quality varies over a wide range. **Concentrated** acid is fed directly into the aerating tower.

3. At Plant III, the raw water is taken from a turbid river. It is subsequently coagulated and filtered before zeolite softening. **Concentrated acid** is proportioned to the **softener influent lines** in amounts necessary to dissipate the phenolphthalin alkalinity and to reduce the total alkalinity to about 20 ppm (parts per million.)

4. At Plant IV, the raw water is obtained from a lagoon located in a marsh. It is chlorinated at the intake, then pumped through a heat exchanger after which it is coagulated with alum and filtered before entering the zeolite softeners.

Despite these differences, it can be seen from Table I that, in every case, for comparable locations the corrosion controlling factors are of the same order of magnitude. It is also indicated that the corrosivity of the water increases as progress is made through the system, up to the point where all the corrosive gases are removed.

Measured Values and Langelier Indexes

Analytical data, such as are shown in Table I, serve to indicate corrosion potentialities, but they do not supply a quantitative indication of the cumulative effects of the several factors involved. In an attempt to obtain data of this nature, corrosion rate measurements were made at key points in two systems, and Langelier indexes were also calculated.

Experimentally Determined Values: In one system, measurements were made with NDHA corrosion testers (1)(references at end) using Bessemer steel wire as test specimens. In a companion system, rectangular bars of gray cast iron were used as test specimens.

The results, measured at comparable points in both systems, are recorded in Table II.

Elsewhere it has been indicated (1) that corrosion rates measured with NDHA testers (using Bessemer steel wire specimens) up to about 10 (as average penetration, inches per year × 1000) predict negligible corrosion of common steel; values between 10 and 20 ((approximately) a moderate rate of attack; and values over 20 a rate of attack likely to cause failures in less than the normal expectancy of standard weight pipe.

When the measured values in Table II are interpreted in the light of this correlation, it is indicated not only that the corrosivity of the water increases as progress is made through the system (up to the point where deleterious gases are purged), but also that where gas-laden acid-treated hot water is involved, common metals are unlikely to give satisfactory service.

Langelier's Index: In 1936, Langelier (2) suggested that for "natural-oxygen-containing waters" it is possible to calculate, from chemical analyses of the water, whether there is a "tendency" for a protective (calcium carbonate) film to deposit or dissolve. He further postulated that where such calculations indicate a tendency to dissolve the film, the water will actively corrode common types of bare iron. The results obtained by such calculations he called the "saturation index," and it was implied that negative values indicate corrosion potentialities about in proportion to the numerical values obtained by such calculations.

Since zeolite softened waters contain virtually no calcium, it might be contended that Langelier's postulates should not have been applied in the present studies. Nothwithstanding, they were applied to the water at various points in the same systems in which measurements were made. The results are shown in columns two and four of Table II. In these instances, at least, the calculated values appear to correlate well with the measured values.

Conclusions

All these findings seem to indicate that in systems of the type in question, corrosion follows substantially the same pattern; that calculations, following the procedure outlined by Langelier, together with NDHA corrosion testers, provide simple and reliable means for approximating the corrosivity of the different types of water involved; finally, that criteria obtained at one location may be expected to hold at others.

(To be continued)

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TRIPPING DEVICE FOR LOW-VOLTAGE CIRCUIT BREAKERS

(Cotninued from page 73)

amp as indicated by the dotted line at D. Such an arrangement would result in getting all that is possible out of the breakers and the system.

One of the outstanding characteristics of the new device is the combination of long time delay to permit motor starting with a wide range of pick-up adjustment that permits it to be applied universally for either motor service or for general load service. The short time delay and combined short and long time delay characteristics would be used in selectivity applications and would, therefore, be on back-up breakers .

The design, the adaptability, the characteristics, and the accuracy of pick-up and timing of this new overcurrent tripping device have been verified by thousands of tests over a two and a half year period. Tests on fluids of various viscosities in structures having different orifices have shown that any desired time characteristic may be obtained. Pick-up tests from 80 per cent to 200 per cent of coil rating in the same unit show that such a unit may be used either to provide for motor starting or for miscellaneous applications, thereby replacing both the old type thermal-magnetic and the so-called dual-magnetic with one universal overcurrent trip unit. Timing, selectivity ,and instantaneous armature pick-up tests on currents up to 100 times coil rating have proven the ability of this device to provide for selective tripping of breakers on all reasonable applications of selective tripping and combined selective tripping and cascade.

The sturdiness of the new trip unit has been verified by its ability to withstand short circuit currents up to 500 times the coil rating. It has also been verified by the ability of the sealed unit to withstand severe shock tests.

The ability of the sealed unit with its silicone fluid to maintain its characteristics throughout a long life is indicated by the operation of six units for over six months at a temperature of 150 C. with no change in characteristics. Some of these units after being sealed for over 1½ years were dismantled, and all of the parts were found to be bright and clean. Tests show that they will operate at all temperatures from 40 C to 100 C.

WHAT THE POWER ENGINEER NEEDS TO KNOW ABOUT

Heat Insulation

Insulation a fairly modern problem . . . Even small boiler plants can show savings when insulation is intelligently applied . . . Case study of a plant with one boiler given . . . Savings in one year amounted to $824.50 or nearly three times the total cost of the insulating job . . . Several suggestions given for retaining efficiency of insulation already applied . . . Moisture penetration one of prime enemies of insulation efficiency . . . Excessive vibration can quickly cause loss of efficiency

KEEPING HOT things hot and cold things cold is a problem which has plagued engineers only during the last few decades. Fuel costs have risen so tremendously and the cost of products produced by the heat have been subjected to such a terrific competitive struggle that temperature has been turned into a precise tool—a tool that can be maintained only by the proper use of good insulation.

Savings Not Confined to Big Plants

The savings, even in one-boiler plants, can be huge. One example, quoted by the Industrial Mineral Wool Institute, was found in a plant where the boiler was operating at a steam gage pressure of 120 psi and a temperature of 350 F. The boiler shell had an area of 400 sq ft. The particular plant in which this boiler was installed had been producing at capacity (it was thought) and it was obvious to everyone that new steam generating capacity would have to be installed if the new orders pouring in were to be taken care of.

Someone had the idea that they might look into the possibility of insulating the boiler in order to provide just the additional amount of steam necessary to both take care of the new orders and also heat the building. A careful study revealed to the management that 2 in. of insulation on the boiler shell would increase to the amount necessary the quantity of steam available.

Formulas Used

The method used to discover the approximate amount of insulation needed, the insulated heat loss and the savings in Btu was as follows. The formula for the heat loss of the pipe when bare was: the unit heat loss in Btu per sq ft per hour. (From Kent's pp 3-64) multiplied by the number of hours operated per year multiplied by the area in sq ft. In this particular case the formula looked like this:

798 Btu $\times$ 400 sq ft $\times$ 8,760 hr = 2,796,192,000 Btu per yr. For the heat loss from insulated pipe the following method was used: Unit heat loss in Btu per sq ft per hr through insulation of specified thickness (Kent's, pp 3-67) multiplied by the number of hours operated per year multiplied by the area in sq ft. This made the formula:

64 Btu $\times$ 400 sq ft $\times$ 8,760 hr = 224,256,000 Btu per yr.

The savings in Btu were then calculated by subtracting the number of Btu lost through insulated pipe from the number lost through bare pipe. This resulted in the following:

2,796,192,000 Btu minus 224,256,000 Btu = 2,571,936,000 Btu per yr.

The conversion of Btu saved per year to fuel savings is made by dividing the number of Btu saved per year by the heat content of the fuel (estimated at 13,000 Btu per lb) multiplied by the operating efficiency. Or, as follows:

$$\frac{2{,}571{,}936{,}000 \text{ Btu}}{13{,}000 \text{ Btu/lb} \times 60\%} = 329{,}735 \text{ lb or } 164.9 \text{ tons of coal saved per year.}$$

Similar calculations can be made for oil or gas. In this particular instance, with coal at $5.00 per ton the saving amounted to $824.50.

The total cost of insulating the boiler shell was $320.00, a cost of 80 cents per sq ft. In other words, it took exactly 4.66 months to pay off the entire cost of insulating the unit. Besides this not inconsiderable saving there was also the added advantage of having a boiler which was able to turn out the necessary additional heat without having to install new equipment. The only question left for the management to ponder was why the boiler hadn't been insulated many years before.

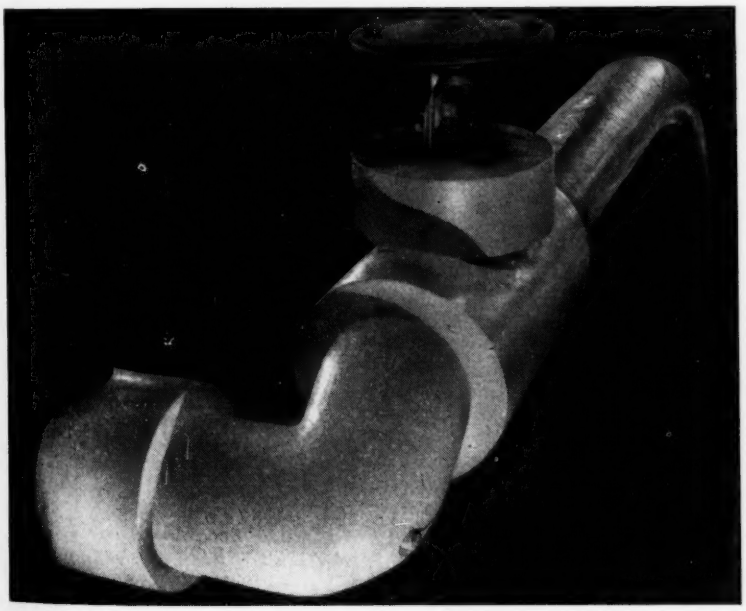

Fig. 1. The insulation on the two companion flanges of this valve will permit maximum return on investment. Insulating cement, which is easily applicable on all irregular surfaces may be reclaimed for reapplication

Retaining Efficiency

Simple suggestions for retaining the efficiency of insulation on pipes and flat surfaces, if followed, result not only in substantial savings but will increase the life expectancy of

Table I. This compilation shows the recommended thicknesses of mineral wool insulation for pipe covering

Steam Pressure or Condition	Temperature	Thickness of Insulation: Pipes 5 in. and Larger	Pipes 4 in. and 4½ in.	Pipes 2, 2½, 3 and 3½ in.
Hot Water		1	1	1
0 to 25 lb	212 to 267 F	1	1	1
25 to 100 lb	267 to 338 F	1	1	1
100 to 200 lb	338 to 388 F	1½	1	1
Low Superheat	388 to 500 F	1½	1½	1
Superheat	500 to 600 F	2	1½	1½
High Superheat and Hot Oil Lines	600 to 700 F	2	2	1½
	700 to 800 F	2½	2	2
	800 to 1000 F	3	2½	2

Note: For outdoor piping increase thickness ½ in.
For underground piping decrease thickness ½ in.

both insulation and equipment. A waterproof jacket properly applied on pipe lines which are exposed to the elements will protect both piping and insulation. This same jacket should be used on inside lines where they are exposed to splashing from process water or other forms of continuous wetting. Insulation also should be protected from moisture entering from the pipe side. Moisture penetration from pipe lines carrying low side refrigerant or cold water can be partially prevented, at least, by sealing the insulation on the pipe side. This requires a more thorough job of sealing than does outside water and weather-proofing. Such lines, when once sealed, should be inspected regularly to make certain no cracks or openings have developed.

When pipe repairs are made replace all covering as carefully as though the entire job were brand new. Make certain that the insulation fits snugly around the pipe. Loose pipe covering will increase the heat loss and may be damaged much more easily than snugly fitting materials.

In many processes insulated pipe lines may be exposed to strong acid or alkali fumes. Jackets are available which will protect the pipe and insulation by resisting these fumes. Such fumes may easily destroy canvas and holding wires or bands and allow the covering to fall from the pipes. Under some conditions the acid fumes may actually attack the insulating materials.

Excessive Vibration

Another thing which can bring about short-insulation life on pipe lines is excessive vibration. Eliminate or minimize all vibration by proper hangers, springs, etc., as constant shaking and jarring may cause joints to open or may reduce the efficiency of the insulation by some other means such as packing. Signs of failure in canvas coverings are oftentimes due to the pipe covering loosening from the pipe. When this happens the covering should be carefully wired back in place and the joints painted with asbestos cement. Replace and paint the canvas. If canvas is not available apply asphalt-saturated felt jackets carefully wired and then cement the laps and joints with lap cement.

Water hammer, remote as it may seem to some, may be caused by insufficient or inefficient insulation. Even if the insulation is not the cause of the water hammer once the cause *has* been discovered and corrected inspect all insulation for damage. The impact of the hammer may open cracks in the covering. Another fruitful source of trouble with insulation can arise when leaks occur in steam or water lines. Steam impinging on pipe covering may cause rapid deterioration. Water from a leak may follow along a pipe for a considerable distance, saturating the covering and thus destroying almost all of the insulating value. At times this has been known to cause the insulation to fall completely off the pipe.

When workmen or maintenance crews are working about the plant do not allow them to load the insulated pipe lines in any manner. Scaffolding, walkways made of boards, etc., may distort the insulation even if it does not crack it outright. Distortion will cause the air cell structure in the insulation to be compressed thus materially reducing its efficiency. The best way to discover for yourself, or to prove to some one else, the efficiency of air space as an insulator is to sit on a pipe carrying high temperature steam and which is insulated with a resilient insulation. The hot seat is an effective convincer.

Reducing Waste

One means of reducing waste is to grind and mix broken pieces of magnesia pipe covering or blocks with water for use as a patching cement. The resulting product is usable but, of course, will not compare in efficiency with the material in its original form. Do not, however, use insulating cement in place of blocks or pipe covering as it is nowheres near as efficient. Insulating cement has been developed for a particular purpose and is only recommended for irregular surfaces where it is not practicable to apply formed materials.

The accompanying tables present information on recommended thicknesses of insulation for pipe covering and for flat surfaces and have been compiled by the Industrial Mineral Wool Institute.

There are many places in the power plant where the advantages offered by properly applied insulation will far outweigh the cost of material and application. One of the least spectacular of these and yet one which will pay the handsomest returns are the many flanged joints which have been left bare in a good many plants.

In one instance reported by the IMWI there were ten sets of 6 in. companion flanges with a bare surface area of 1.82 sq ft each. Steam was passing through the lines at 350 F. Two inches of insulation was applied. The cost of insulation, including some outside weatherproofing, came to $3.00 per flange or a total of $30.00 for all ten. It was later calculated that this seemingly trivial job was saving up to 7 tons of coal per year.

Duct Insulation

Everyone recognizes that proper duct insulation cuts fuel and energy costs, prevents heat from radiating into or being absorbed from work areas, and makes possible greater control over heating and cooling systems.

But not everyone recognizes the importance of following proper and tested installation techniques. Time-tested and approved steps are described to be followed in applying mineral wool insulation to ducts are described in the following:

The three general duct usages

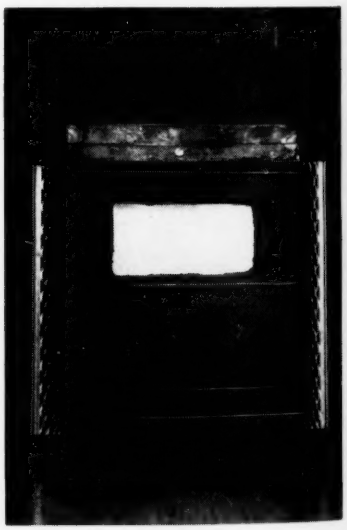

Fig. 2. This photo shows the manner of reinforcing the corners of ductwork insulation by use of metal angles

Table II. Recommended thickness of mineral wool insulation for flat surfaces are given in this table

Operating Temperature Degrees F	Thickness inches
100 to 200	1 in.
201 to 300	1½ in.
301 to 500	2 in.
501 to 700	2½ in.
701 to 900	3 in.
901 to 1100	3½ in.
1101 to 1200	4 in.

which require insulation are 1) carrying hot gases, 2) carrying air for room heating and air conditioning, and 3) carrying cool gases. Insulation of ducts used in ordinary room heating is primarily valuable in preventing heat from being dissipated before reaching its destination. When cool air or gases are carried in insulated ducts, the additional annoyance of deteriorating condensation sweating is prevented. Operating expense, of course, is a factor in every case.

For inside installations, where the temperature gradient is not great, the following procedure is recommended: 1) Clean the duct of all grease and dirt. 2) Cut mineral wool blocks to conform to the area to be insulated. 3) Wire the blocks to the ducts. Galvanized or expanded metal angles are recommended to keep the blocks in line at the corners, as shown in Fig. 2.

When the temperature gradient is greater than that encountered in room heating and air conditioning additional steps are advised. As illustrated in Fig. 3 they are: 1) Trowel a ½ in. coating of mineral wool insulating cement over the surface of the blocks; 2) Follow this with a layer of 1 in. mesh poultry netting; 3) Apply a ¼ in. coating of finishing cement.

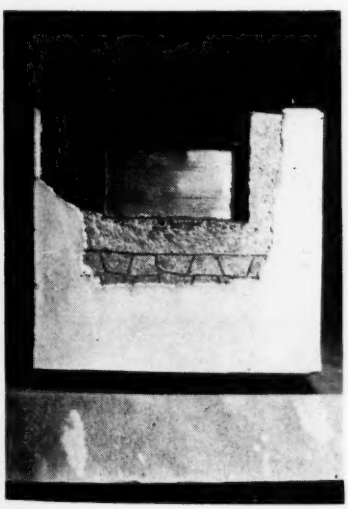

Fig. 3. The various layers of insulation material are shown here. They are: insulating cement, 1 in. poultry mesh netting and a ¼ in. coating of finishing cement

In cases where the contents of the duct are at a lower temperature than the surroundings, an asphalt or other type of vapor barrier must be applied to the insulation exterior. The purpose of the vapor barrier is to prevent atmospheric moisture from permeating the mineral wool and condensing therein, thereby spoiling its insulating qualities. Asphalt is also useful in cementing the mineral wool blocks to the duct before wiring them in place, and for preventing corrosion.

Commercial Standards

Good practice in the installation and use of insulating materials has been published in Commercial Standard CS117—44 issued by the U. S. Department of Commerce and available for 10 cents from the Superintendent of Documents, Washington, D. C. This standard has been voluntarily accepted by a large number of the leading associations and companies in the country.

WHAT IS THE ANMB DOING?

(Continued from page 67)

parts required both in the actual fabrication of the products and the tooling necessary to produce the products.

Naturally the standby facilities which were operated in World War II form an important consideration in this phase of the planning. It has been determined that approximately 100 plants should, if enabling legislation is enacted by Congress, continue to be government-owned. There should also be a number of government-owned plants released for sale with what is termed the "National Security Clause," a clause inserted in the lease which provides for a claim upon the plant on the part of the Secretary of War and/or the Secretary of the Navy in case of an emergency.

In addition to the industrial production required, there is the problem of setting up certain agencies necessary to handle production of goods that might be utilized by the armed services and production of goods that are absolutely necessary for the civilian economy. In addition to this, we are emphasizing over everything we have, the need for a constant revision not only of this phase of the industrial mobilization plan but of all phases. We have a saying in our shop that we will write the 1947 Industrial Mobilization Plan and the minute it is finished we will start on the 1948 Plan; and it is our hope that this will be done every year of our country's life. The economic situation changes and the political situation changes, the weapons change, and any plan of this sort must be written with these changes in mind. The Industrial Mobilization Plan will be revised in the light of a changing situation as weapons become obsolete and new ones will take their place. To illustrate, if the future plane is going to use a fuel entirely different from octane gas, our plants making such gas become obsolete and plants capable of producing the new fuel become all-important.

We would like to have such a plan each year read and noted as produced and would welcome comments from the President of the United States, the Secretaries of the services, heads of important departments of the country, such as Commerce, Interior, etc., and by the heads of the military committees of the Senate and Congress. To us, this seems very important in keeping the responsible administrators of our country familiar with what is going on and with the opportunity, as the plans are formulated, of making whatever comments seem best to them in light of current conditions.

Our schedule or "time table" of preparations may be divided into three different phases: (1) The work that should be done in peacetime preparing the plan to meet an emergency; (2) the actions and steps that will be necessary from the time trouble might appear until it actually descends upon us; (3) the setting into action of all the necessary agencies, bureaus, production, etc., when trouble has actually descended upon us. As I have previously stated, an effective industrial mobilization plan must be a plan by representatives of all Americans. Thus the Board has developed a program of industry advisory committees to assist in the discussions and preparation of the plan.

The Board is trying to visualize a set of conditions that may be ahead of us. No one can possibly write a master plan today which would be effective 25 years from now, but we do believe it possible to write a plan today that could go into effect next year. I emphasize the importance for men of industry, men of science, and the administrators of our country to realize that any Industrial Mobilization Plan must be a changing one, reviewed and revised in the light of current thinking.

INGOTS OF METAL that take pictures of themselves are produced by Westinghouse scientists who inject doses of radio-active atoms into steel, and other alloys. The tagegd atoms shoot out rays and particles at a photographic film. The resulting pictures showing the the position of the atoms are helping determine the causes of rust and brittleness.

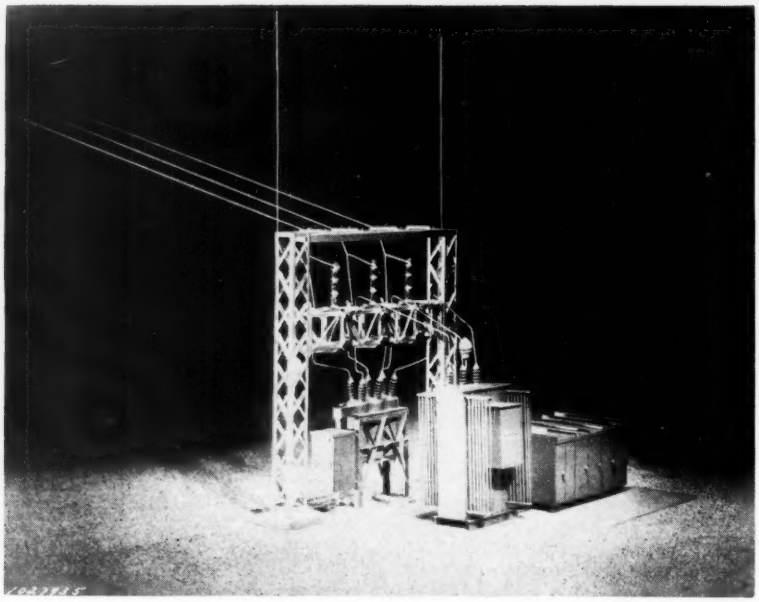

Fig. 1. View of a model of a simple package substation

New Substations at Investment Savings

The development first of the "unit" substation and later of the "package" substation makes possible the elimination of considerable construction and installation costs. With the package type of substation erection time is reduced to a minimum and large members and parts are shipped from the factory complete and ready to install without a great deal of field construction

By MARVIN R. KIMBRELL, JR. *Unit Equipment Division, General Electric Co., Schenectady, N. Y.*

NORTH, EAST, SOUTH AND WEST—in all parts of these United States, the Electric Utilities are urgently in need of new and larger substations. Why? Because—the manufacturing plants, the commercial organizations, the homes, and the farms—the consumers of electrical power are demanding more electrical power than at any previous time in electrical history.

Many Electric Utilities find themselves today with little or no spare substation capacity. During the recent war years, practically all available substation spare capacity was placed in service, either to meet the heavy power demands of war plants, or to replace electrically damaged substation equipment. Raw materials for the production of new substation equipment were not obtainable during the war, except under high priorities.

Today, therefore, the Electric Utilities are purchasing and installing new substation equipment to meet new and increased power demands. A new substation means a high financial investment on the part of the Utility. Of more serious consequence is the fact that the factors contributing to the total installed cost of the substation are at an unprecedented high level. Material and equipment costs are high. Labor for the installation and engineering costs for the design of substations are heavy. There are considerable taxes to meet on the investment.

Every Utility, despite the consumer demands for electrical power, seeks a method by which they can reduce their investment costs for a new substation. This article suggests a plan that may prove of benefit to many in reducing system investments. Not all the details are given, but the basic fundamentals of the plan are explained.

The Unit Substation

In 1931, the electrical manufacturing industry introduced to the purchasers of substation equipment the "unit substation." This new sub-

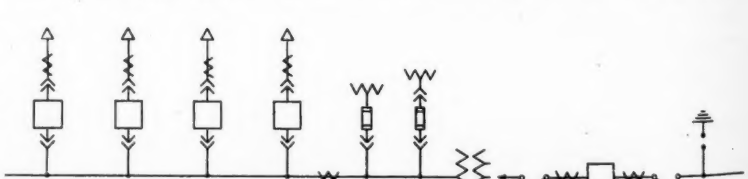

Fig. 2. One line diagram of the substation shown in Fig. 1

station development consisted of a transformer section and a low voltage switchgear section, united into a coordinated, compact unit. Since the introduction of this new idea in substations, many installations by industrial concerns and utilities have proved that lower installed substation costs are possible. By itself, however, the unit substation did not fulfill all of the requirements of a substation as desired by the electric utility. In addition to the unit substation, there was a need for an incoming line steel structure, and its associated equipment, high voltage line protective equipment, and high voltage oil circuit breakers. In answer to the needs and demands of the utilities, the electrical manufacturing industry very recently introduced a complete substation that included all of the substation equipment required. This new and complete substation is the "package substation." It makes available at lower installed costs a complete, ready to install, distribution substation, including all of the equipment required between the terminals of the incoming high voltage lines and the outgoing feeder circuits.

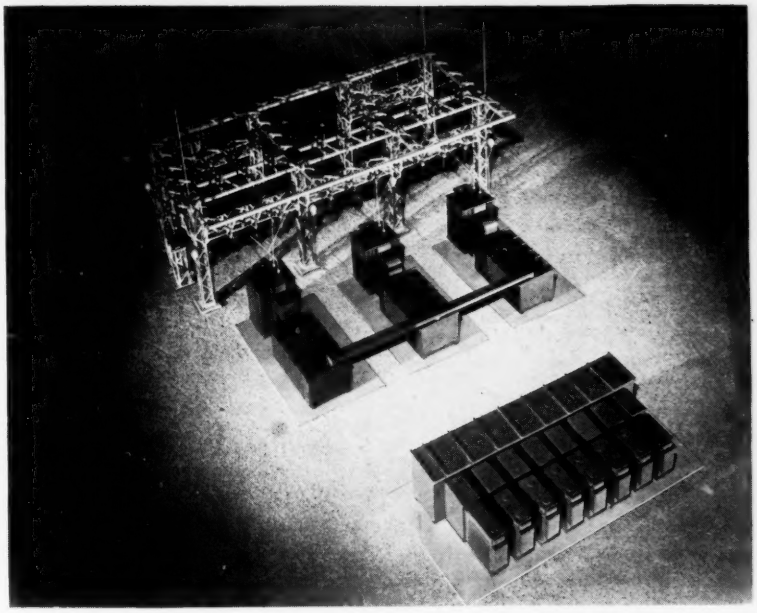

Fig. 3. Model showing a more complete substation than the one shown in Fig. 1

Package Substations

Figure 1 shows a view of the simple package substation. The one line diagram of Fig. 2 shows the electrical arrangement of the equipment installed. This type of substation is provided with high voltage equipment, consisting of lightning arresters, hook operated disconnect switches, oil circuit breaker, and the unit substation. Transformer differential relaying is usually provided for this substation arrangement. The low voltage system is radial and the circuit feeders are bus regulated.

A more complex package substation is shown in Fig. 3 with its corresponding one line diagram shown in Fig. 4. This is a low voltage selective substation for loop or multiple circuit subtransmission systems with individual feeder regulation. The two high voltage oil circuit breakers will clear high voltage line faults without de-energizing the station. Transformers are fused to clear transformer faults without interruption of service on the rest of the station. Individual feeder voltage regulation and low voltage breaker by-pass facilities are obtained by means of a regulator-transfer-bus unit, shown in the right hand foreground.

It has been stated that the package substation, examples of which were explained by the two preceding paragraphs, offers investment savings to the electric utility. In order to determine these savings, a comparison between the package substation and the conventional piecemeal substation must be kept in mind. There are three fundamental savings — reduction of detail engineering costs, reduction of purchasing detail costs, and minimization of installation costs. How are these savings made possible?

When a new substation is required, the first step toward establishing the substation is engineering design. This work involves the preparation of electrical diagrams showing the coordination of all the equipment involved in the substation. When equipment from many manufacturers is involved, this work is extremely important due to the variable electrical characteristics in equipment from different manufacturers. Layout drawings showing the physical location of lightning arresters, disconnect switches, transformers, switchgear, steel structure members, and overhead bus work must be prepared. Instruction drawings must also be prepared to enable construction personnel to properly locate and to make proper electrical connections of the many pieces of equipment in the substation. These engineering requirements involve cost directly accounted against the particular job order of the substation to be installed.

Savings with Package Substations

With a package substation, this engineering work is minimized to a simple one line diagram such as has already been shown, plus a brief explanation of the desired scheme of operation. With this information available, the electrical manufacturer can prepare detailed specifications describing the package substation he will be able to supply. If this package substation is purchased, the manufacturer will assume the responsibility for the complete coordination of all the equipment involved. Construction drawings, electrical diagrams,

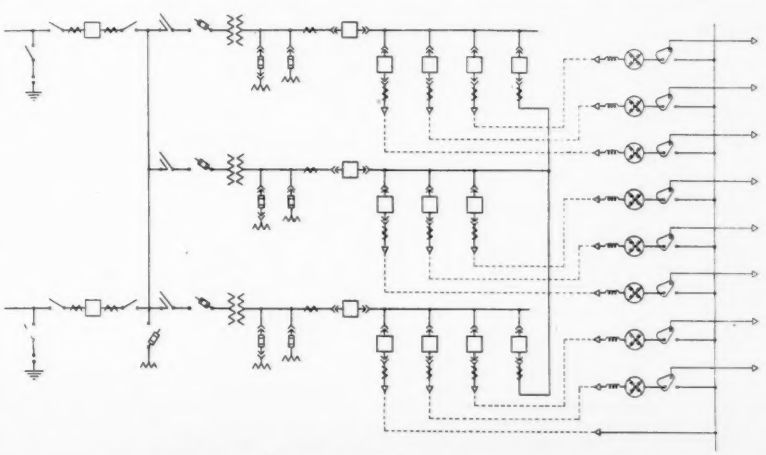

Fig. 4. Corresponding one-line electrical diagram for unit in Fig. 3

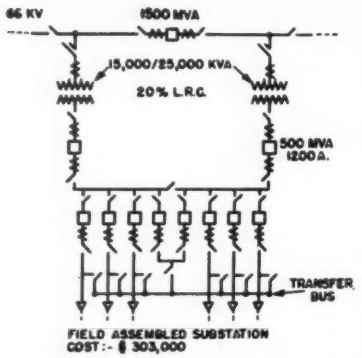

Fig. 5. One-line diagram of a field assembled substation. The total cost of this installation was $303,000

and operating instructions will be furnished by the manufacturer. With the required engineering work as a part of the manufacturer's proposition, the costs of this work can be eliminated from the electric utility's overall installed cost of a new substation—meaning investment savings.

The saving in engineering as explained in the preceding paragraph, means actually further system savings to the Utility. The engineering personnel, relieved of detail substation engineering, are able to concentrate on engineering studies of the entire distribution and transmission system, where savings of greater magnitude than those outlined in this article are possible. These studies involve such programs as substation standardization, lower system operating costs, and improved service.

When the electric utility purchases equipment for the new substation from various manufacturers, many purchasing problems are involved. The purchasing department must coordinate the placing of all orders so as to insure the delivery of the required equipment at the substation site as desired in the erection schedule. This plan of many purchase orders requires further that a thorough checking be made to insure that all

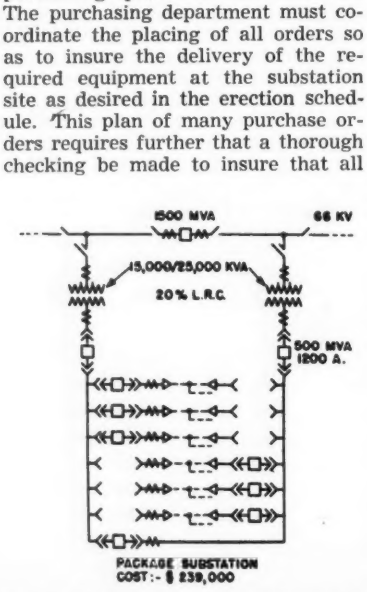

Fig. 6. One-line diagram of package substation offering same function as the one shown in Fig. 5. Total cost of this installation, $239,000

equipment required has been ordered —no items overlooked. This work on the part of the purchasing department must coordinate the placing of all orders so as to insure the delivery of the required equipment at the substation site as desired in the erection schedule. This plan of many purchase orders requires further that a thorough checking be made to insure that all equipment required has been ordered—no items overlooked. This work on the part of the purchasing department is time consuming and is, therefore, a cost accounted against the job order of the new substation.

With the purchase of a package substation, these purchasing problems can be eliminated. Ordinarily, bidding specifications have been prepared by the various electrical manufacturers. The electric utility's purchasing department need issue only one purchase order calling for a package substation, in accordance with the specification of the manufacturer given the order. The responsibility for coordination of shipments is placed upon the manufacturer.

The installation of equipment and erection of the steel structure in the conventional piecemeal substation is probably more of a contributing cost factor than any of the two already mentioned. Outdoor, frame mounted, low voltage circuit breakers, transformers, high voltage equipment, and the steel structure members must all be located and pieced together. Supporting columns for the structure must be fabricated; cross members for the various devices must be fabricated; bolt holes for securing devices must be located and drilled. All of this work involves time and personnel costs that are extremely high. The greater the number of pieces involved, the longer the erection time or the greater the number of construction personnel involved.

With the package substation approach, erection time is narrowed to a minimum. The equipment and steel members are shipped in units as large as can be easily handled by the construction personnel. The number of pieces to be joined together is at a minimum. Supporting columns arrive at the substation site prefabricated. Cross members have devices already mounted in place or bolt holes for securing devices to the structure have already been drilled. The unit substation itself is ready for operation after simply bolting the transformer section to the switchgear section and making connections of the high voltage and low voltage cables. The speedy and simple erection of the package substation greatly reduces the construction costs and makes possible a third investment saving for the electric utility.

It is of particular importance to point out the underlying factor importantly contributing to the lowering of the installation costs. The substation structure is prefabricated by production line machine tool methods. The cost of machine tool production is very low, compared to that of hand labor production. Assuming that the ratio is one to ten, and realizing the increased costs of labor during the recent years, it is self-evident that the machine tool production is less affected by these increased costs than hand labor production.

Many electrical utilities have made comparative studies of similar package substations against substations they now have in service. Based on comparable bills of material, they have found these investment savings

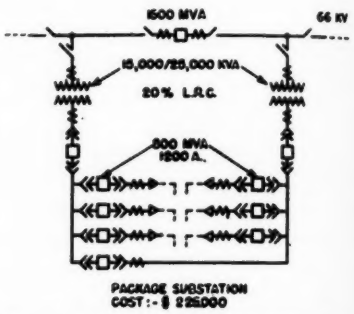

Fig. 7. Another package substation with facilities not quite as complete as those of the one shown in Fig. 6 but in this case the investment is only $225,000

in engineering, purchasing, and erection, to be true. These comparisons have indicated that investment savings averaging 20 per cent of the total installed cost of the conventional piecemeal substation are made possible by the installation of a package substation.

Examples of Savings

Examples of these savings may be found by reference to Figures 5, 6, and 7. Figure 5 shows the one line diagram of a field assembled substation. The total installed cost of this substation was $303,000. Figure 6 shows a package substation one line diagram that offers the same functions as desired in the field assembled substation. The total installed cost of this substation was $239,000, or a saving in investment of 21 percent. Even greater investment savings were offered by the package substation as shown in Fig. 7. Here the transfer and by-pass facilities are not as completely available, but the cost of the substation being $225,000, there was an investment savings of 25 per cent possible.

The electric utilities are in need of new and larger substations, and they desire these new substations at lower financial investments. A plan designed to make possible lower installed substation costs has been suggested. The complete, factory prefabricated, ready-to-install, package substation offers investment savings to the electric utility system.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

TELL ME QUICK AND TELL ME TRUE (OR ELSE, MY LOVE, TO HELL WITH YOU)

By VICTOR O. SCHWAB

I see that you've spent quite a big wad of dough
To tell me the things you think I should know.
How your plant is so big, so fine, and so strong;
And your founder had whiskers so handsomely long.
So he started the business in old '92!
How tremendously int'resting that is . . . to you.
He built up the thing with the blood of his life?
(I'll run home like mad, tell that to my wife!)
Your machinery's modern and oh so complete;
Your "rep" is so flawless; your workers so neat.
Your motto is "Quality" . . . capital "Q"—
No wonder I'm tired of "Your" and of 'You'!
So tell me quick and tell me true
(Or else, my love, to hell with with you!)
Less—"how this product came to be";
More—what the damn thing does for me!
Will it save me money or time or work;
Or hike up my pay with a welcome jerk?
What drudgery, worry, or loss will it cut,
Can it yank me out of a personal rut?
Perhaps it can make my appearance so swell
That my telephone calls will wear out the bell;
And thus it might win me a lot of fine friends—
(And one never knows where such a thing ends!)
I wonder how much it could do for my health?
Could it show me a way to acquire some wealth—
Better things for myself, for the kids and the wife,
Or how to quit work somewhat early in life?
So tell me quick and tell me true
(Or else, my love, to hell with you!)
Less—"how this product came to be";
More—"what the damn thing does for me!"

The AMSCO Bulletin

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 W. Jackson Blvd., Chicago 4, Ill.

Power Conferences Is Great

By BILL UPDRAFT

A COUPLE OF MONTHS ago I reads a piece in the Power Plant Engineer about the East-West Power Conference which was going to be held at Hohokus, Iowa. It is held at Hohokus, Ia. being as that is halfway between the effete east and the virile west. So I starts in to sell the boss on the idea of me going.

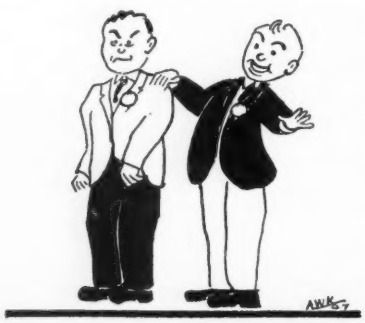
The boss ain't impressed at first. "Nix," he growls, "them conferences is the bunk; just a lot of baloney. You don't learn nothin' at them shindigs—all they do is get drunk." Maybe he's got somethin' there but I don't take no for an answer. The boss is all right—a good guy, but a little old fashioned when it comes to giving out with the higher education. So I works on him during the ensuing weeks and gradually batters down his resistance. I tells him that if I goes to the conference I will come back with a lot of hot ideas for improving the power plant. "Watdahell," he expostulates, "ain't the power plant doin' all right? What do I pay you for but to keep it improved?"

That sort of floored me for a minute but I tells him that 2 heads is better than 1, and 600 heads is better than 2, and so I is bound to get some good ideas at the power conference. As I knew he would, he finally weakens and in due course I heads for the conference.

I arrive early in the am, and after getting a room at the hotel, I gets myself registered with a badge and everything, only they misspell my name on the badge. A lot of fellow ingineers is milling around, shakin' hands, pounding each other on the back, and chewin' the fat; its yackaty yak all over the place. The noise level is at least 3 db above that in a boiler factory.

I'd been there only three minutes when some lug hits me on the back and shouts, "Well, wadya know, if it ain't old Bill Updraft himself. Wadya doin' here, Bill?" The question is silly but I don't allude to that and shouts back, "Well, wadya know, here's Pulverizer Pete himself." So we exchange pleasantries, him telling me he's got a couple of tomatoes lined up for the evening—"What about it Bill?" I declines.—"Nix, Pete," I tells him, "No dames for me—I'm here to wise up on the thermodynamic stuff and I just bought me a ticket for the 'Old Engineers' banquet—cost me 5 bucks."

"Ok, OK," he says, gently, seeming to look sort of sorry for me. It's your funeral, Bill. Remember, I gave you first chance—these is pretty swell babes."



Well, Wadya know, if it ain't old Bill Updraft himself

The Meetin' Begins

Just then, however, some baldheaded guy on the rostrum begins poundin' the table with a hammer and, poking his face into a microphone, announces that the meeting will please come to order. I guess most guys in the audience is deaf because they keep on with the yakaty yak. So the guy on the platform pounds the table harder and finally they gets the idea and the noise level subsides to that of a rock crusher. After a minute of dignified silence, the chairman begins to speak.

"Members of the East-West Power Conference," he orates. "It is a great privilege for me to wel - - -" at this point the loud speakers begin to howl and the guy has to back away from the mike. So he starts over again but as soon as he gets started the PA system again goes into a howl. This sort of gets his goat, so to speak; he looks annoyed and backs away once more. After the 4th time, he gets the idea and gives the mike a wide berth, only then we don't hear so well.

It's a Wonderful Privilege

He orates what a wonderful privilege it is for all of us to attend the conference, how freedom of speech is one of the cornerstones of our democracy (Applause) and how what will be said at this conference will affect the welfare of the whole nation. After 10 minutes of this he announces the amazing fact that he is not there to make a speech—he is only there to introduce the mayor who was to extend the official welcome of Hohokus to the members. Only, the mayor ain't there; he had a important engagement some other place, but he sent the Corporation Council in his place. The Corporation Council, who is fat, gets up on his feet with some difficulty and tells us what a wonderful privilege it is for Hohokus to have us as their guests—how ingineering is one of the cornerstones of our democracy and that he himself is an ingineer at heart. He tells us how he used to fix the electric bell at home when he was a kid and that only the irony of fate made him become a lawyer. But he points out that ingineering and law are very close—"very close, indeed." Don't all the city ingineering contracts have to be signed by the lawyers?

It seems that the governor of the state also was to be there but he, likewise, had an important engagement and he sends a telegram telling how sorry he is at not being able to be at this here great engineering congress, but he welcomes the members to the state where the tall corn grows. Corn is right, thinks I.

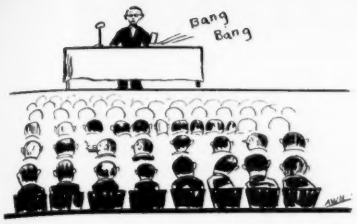
Finally, the welcoming part of the program is over and we gets down to brass tacks. The chairman announces that the first technical paper "Will the Diesel Engine Survive?" will be presented by Mr. Homer J. Snapring. He adds that we are a little short of time, so will the authors please confine their presentation to 15 minutes.

Homer Snapring Orates

So Homer Snapring comes forward armed with a stack of paper that must have taken him six weeks to write. He lays the stack of paper on the table, looks around at the audience, takes his watch and chain off, lays it on the table, pulls the mike over and adjusts the height to suit him, and starts to read the paper. He can't read very good.

Of course, I ain't got any interest in Diesels but at least, here is a chance for me to learn something, I thinks. Homer goes back to the discovery of fire by primitive man. He slashes through history like nobody's business; the invention of gunpowder, the Egyptian shaduf, James Watt, Newton's second law, the theory of least squares flash by like Bill Odon's, Bombshell. Boy, I thinks, this guy knows his stuff. After 25 minutes, he hasn't even come to Rudolph Diesel and I begins to wonder where the Diesel fits into the picture. The chairman, meanwhile gets figity and keeps lookin' at his watch but Homer evidently doesn't know he has a watch, or maybe the poor guy can't tell time. At the half hour mark, the chairman, finally, asks him to finish his paper as soon as possible—time is getting on. Homer looks annoyed and looks at the remaining stack of paper—he is only half through. After a second warning, ten minutes later, Homer gets the idea and brings his paper to a close. He turns to the last page of his opus. The Diesel Engine? Of course, it will survive -- doesn't he work for the Ratakiller Diesel Engine Co.? There will be bigger and better Diesel Engines.

By this time it is almost time for lunch so the guy in charge of the session says that there will be time for only limited discussion. Will the discussers please come forward to the platform, announce their name and company connection, speak into the microphone and limit their discus-



Some guy begins poundin' the table with a hammer

sion to 3 min. So some fellow gets up and without bothering to give his name or even to come out into the aisle, says that he wants to compliment Mr. Snapring upon having presented a most interesting paper, that he agrees with Mr. Snapring hook, line and sinker, or words to that effect, but he would like to ask Mr. Snapring one question; what will happen to the Diesel engine when the nation's oil supply runs out? This sure is a stickler and Brother Snapring seems worried at first but is equal to the situation and says that in his opinion the nation's oil is still good for many years and that no one needs to worry about it running out.

By this time most of the guys in the audience is chewin' the fat so it don't make any difference what is said and, anyway, most of them is hungry and starting to leave the room to put on the feed bag.

We Put on the Feedbag

So Pulverizer Pete and me, makes our way out to the ballroom which is set with a lot of round tables and a long narrow table at one end of the room. This is where the big shots sit. It seems we are going to be privileged again, this time to hear C. Eustace Krump speak on "Whither Democracy and How." Mr. Krump, the program says is President of the Useless Pump Corporation.

Pulverizer Pete and me sits down at one of the tables where some other guys is already attacking the rolls and celery. The one next to me sticks his hand out and says, I'm Chester W. Nimitz—it sounded like that, maybe it was Lester W. Spinich, anyway it doesn't matter. I tells him who I am and he introduces me to the other guys at the table. I give each one the high sign and then go on listening to Pete who is telling me how to make desuperheated steam with dry ice. The other guys is talkin' to each other.

No Floor Show

After almost finishing a little piece of ham, a spoonful of wrinkled canned peas and a small hunk of potato, the waiter grabs my plate and puts a small dish of this here furnace-lining ice cream in front of me. I tries my spoon on it but it bends, so I try my fork. This works better but the stuff is so hard I almost crack a tooth so I gives it up and gulps down a cup of dubious Java; tastes like its got saltpeter in it. Then the waiter comes around and collects three bucks. "What the three bucks for," I ask him, "is there goin' to be a floor show?" He gives me a dirty look and collects three bucks from the guy next to me. "Boy," I thinks, "this is a pretty good racket; 3 bucks for 30 cents worth of grub." But then I thinks, "Oh, well, it goes on the swindle sheet, so wotthehell." I'm still hungry when one of the big shots at the speaker's table begins to rap a knife against a water glass. After 3 or 4 tries, the guys finally stops gabbin' and he announces that it is a great privilege to have the honor of addressing this wonderful meeting and to be able to introduce the speaker. Before doing this he wants to introduce the other guests at the speaker's table. So each bozo stands up, grins a sickly smile as their names are called and sit down again. This is all very inspiring, I guess. Then Krump gets up and clears his throat. "Members and guests of the East-West Power Conference," he warbles. "It is indeed a great privilege to address this splendid gathering of ingineers. Engineers are the lifeblood of the country, the bedrock of our civilization, etc." By this time I get the idea that ingineers must be pretty sharp. Don't all these guys say so? Well anyway, Krump tackles "Whither Democracy" with a vengeance. He doesn't mess with it. He brings in Russia, he slings in freedom of speech, he lambasts the Bolshevicks. Krump knows he's good. He bangs on the table. He glares at the audience. "Where would we be today," he shouts, "if we ate Borsch as a steady diet? No sir, plain old vegetable soup was good enough for my grandpop and it is good enough for me. (Great Applause) After a half hour, Krump wipes his brow and sits down. I still don't know "whither democracy" but everybody says it was an inspiring speech and so I guess I musta fallen asleep during part of it.

Atomic Energy

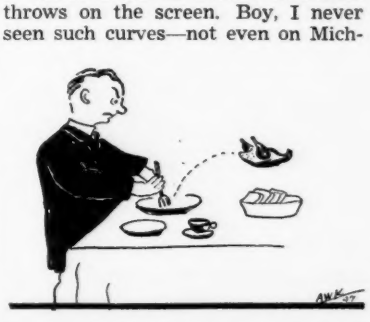
Next, we piles into the afternoon session. Some guy is to tell us about atomic energy. I wants to hear this because I figure if I can rig up our plant to use this here atomic energy, we will save on our coal bill and I'll stand in pretty square with the boss. And anyway, this is to be an "illustrated" lecture—the guy is going to show a Navy film called "Operation Crossroads." The guy what gives the lecture is a little shrimp,—guy by the name of Bramer, or something—maybe it is Cramer. He is supposed to have been at Bikini but it seems we is just wastin' the taxpayers money by sendin' guys like that to Bikini because the first thing he says is that he is not goin' to talk about Bikini since the talking film will tell all about that. So he start in on atomic energy; he jabbers about a lot of things, like neutrons, isotopes, chain reactors, k factors and a lot of other crazy things no one every heard of. One guy in the audience yells—"Get down to earth pal, you're way over our heads." This sort of floors the poor guy and I feel sorry for him—a little. But then ignorant goofs like that should not be allowed to speak to a bunch of ingineers like us. Well anyway, he keeps on slingin' neutrons until everybody is half asleep and nobody knows what he is talking about. Finally, he is through and says, now we'll see and **hear** the picture. So the lights go out and the picture starts. First there is a lot of airplanes flying around like crazy; then there is a flash of some naked native talking to a bunch of other naked natives—but no sound comes out of the movie. "Where is the sound?" somebody yells. So there is a lot of commotion back where the moving picture machine is and then some guy runs up to the stage and bangs on the loud speaker but it only grunts. No sound comes out. In the meantime, the picture runs on; airplanes flying like crazy, ships milling around, a couple of shots of some goats, a lot of brass hats, a picture of a pig, but no sound.

Finally, the guy what is supposed to have been at Bikini gets up and tries to tell what the picture is all about but I don't think the poor bozo ever seen it himself because he don't know nothin' about it and he finally sits down. So the picture runs out! No sound.

Then the chairman comes out on the stage and thanks this guy Framer, or Bramer or whatever his name is and says he is sorry there was no sound but they just found out that the phototube in the moving picture machine was burned out. Ingineering sure is great. But I still don't know nothin' about atomic energy and so I can't surprise the boss.

Gas Turbines is Coming

Well, I thinks, if the atomic energy talk was a flop, the next one won't be. This is on gas turbines. Now, this here gas turbine is supposed to be pretty hot and I figure if I can tell the boss about it, sell him on the idea of putting one in, we can just junk our boilers. The guy what gives this is a professor of some sort and when he gets up he gives the audience the once over and then sails into a whole mess of curves which he throws on the screen. Boy, I never seen such curves—not even on Mich-



The rubber duck keeps bouncin' off my plate

igan Boulevard. They go crosswise, up and down, some are wavey and some make circles. The prof talks about heat cycles, fluid masses, enthalpy, about everything except gas turbines. Finally I gets the idea that nobody so far has got one of these here gas turbines except some oil refineries. So I guess I got to stick to my old non-releasing corliss engine for some years to come.

By that time I gets pretty disgusted and I am about to tell Pete to call them dames he mentioned when the chairman announces a paper on spreader stokers. Boy, this is just up my alley! I been trying to sell the boss on the idea of getting one of these here spreader stokers for over a year but so far he don't wise up. What's the matter with the shovel you're using he always says. I try to tell him that it is out of date, that things is done automatic now. But he don't listen. So the fellow on the stage shows how swell these here spreader stokers are and how much money you save by putting one in. Boy, I says to myself, here is where you can get in square with the boss. I makes notes of the savings the fellows says we can make.

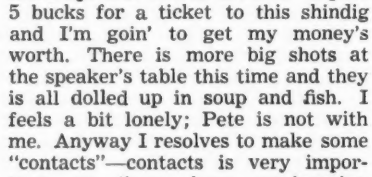
I Makes a Contact

That night, I attends the banquet. All the big shots is there and they all look as if they had a couple of snifters before they came. There is also some dames but they don't appeal to me and I keep wondering about the tomatoes Pete said he had lined up. But it was too late—I paid 5 bucks for a ticket to this shindig and I'm goin' to get my money's worth. There is more big shots at the speaker's table this time and they is all dolled up in soup and fish. I feels a bit lonely; Pete is not with me. Anyway I resolves to make some "contacts"—contacts is very important at these here engineering meetin's. So I sits down at a table where two other fellows is sitting. They look sort of forlorn too. "I'm Bill Updraft," says I, sticking my paw out. "Plestamecha," retorts one of the guys. "Watcha think of the meetin'? Great I tells him—its a great privi," but I catches myself—it don't sound original. "I mean its a great meetin'."

"Yeah," he says, "it's a great meetin' all right; have some celery. You an engineer?"

"Yep," I snaps back. "I'm chief at the Cleanum Laundry over at Peoria. Where's your plant?" I asks him.

"Oh," he says, "I ain't got any plant. I work over at the Royal Drug-



The Doc slings a mean vocabulary

store—I ain't an engineer but my uncle is—he just gave me the ticket to this shindig; told me I could get a good feed."

A soda jerker! Well, I thinks, here is a good contact if you are interested in jerkin sodas. Anyway, he's a nice enough young feller and in the course of the evenin' he gives me the low down on how to make money in a drug store. There's a lot of interestin' angles to it.

The chow ain't too bad at this feed, except that the rubber duck they put on my plate keeps bouncing off every time I sticks my fork in it. Pretty soon the MC at the table where the big shots are, stands up and makes a lot of wise cracks, some of which got whiskers on them, but everybody laughs anyway. Then he quits kiddin' and tells us what a privilege it is to address the meetin' and what an honor it is to introduce his old friend Dr. Aloysious Crankshaft. The Doc, he says, is going to speak on "The Ingineer's Place in Society."

The Doc is a live wire. He snaps up on his feet in two shakes of a lamb's tail and after telling us what a great privilege it is to address this gathering of ingineers, he yanks a bunch of papers out of his pocket and starts to read. Boy, he sling a mean vocabulary, if you know what I mean. He don't begin with the discovery of fire—he just starts in at the beginning where just some dust is swirling around in the cosmos, whatever that is. He brings in the dinasaurs—them big lizards you see in the Sunday papers—he tells about the ice age and rings in some guy by the name of Cromagnon or somethin'; some mick, probably. Then, we get to Egypt and the pyramids—the guys that built these rock piles he tells us was ingineers. Pretty soon Columbus sails across the ocean and discovers New York—Columbus, he guesses was an ingineer.

Throw the Politicians Out

By this time a lot of the guests is asleep—full of rubber duck—but the Doc never stops. He reads away. The steamboat comes in but first the Doc tells about Jim Watt who sits by the fire and watches a tea kettle. He was an ingineer. Finally the Doc gets to politics. It seems these here politicians what is running the country don't know enough to get in out of the rain. They is runnin' everything wrong. What we need is some ingineers in politics. Ingineers should throw the politicians out and get the jobs for themselves. It sounds like a good idea to me and maybe when I gets back, I will tell the boss, I'm thinkin' of carvin' out a political career—maybe that will scare him into buyin' one of these here spreader stokers.

By the time the Doc sits down, the evenin' is worn out and so is most of the guests; but not the Doc. He will be glad to answer questions, the MC says. But nobody has got any

Meet Mr. Smaltz of the Edison Power Co.

questions so the shindig breakes up. I hear some guys talkin' about the Doc's speech—it was an inspirin' speech. Maybe they meant expirin'.

The next mornin' I gets down to the meetin' room bright and early. It is supposed to start at 9 am but when I gets there nobody is around. I guess most of 'em is got the headache so I sits down and pretty soon some other guys come in. By the time the meetin' starts at 10:15 am there is only a handful in the room. There is a paper on Hydro plants in Florida and another one on the Design of 150,000 kw turbines. I ain't never been in Florida and the 150,000 kw turbine is a little big for our laundry so after a while I wanders out into the hall where I runs into Pulverizer Pete. He looks sort of bedraggled but he slaps me on the back and says, "Boy, Oh Boy, you shuda bin at the French Casino wid us last night." I grins, and says "Maybe I should." and I ain't kiddin'.

Back in Peoria

I feels a little better the next day, back in Peoria, and know I can talk the boss into getting that stoker. I am goin' to be smart though and work the political angle first—sort of scare him into it. When I get to the plant there is a guy in his office with a brief case full of papers. The boss spies me outside the door and yells, "Come in here Bill, want you to meet this feller."

So I walks in dignified like and the boss says, "Well, Bill, how was the power conference?"

"Swell boss," I tells him. "Very swell. It was a great privilege——" But I stops myself. "By the way, Boss," I goes on, "I been thinkin' of carvin' out a political career for myself. There is great opportunities in Washington, for good ingineers."

I looks to see his face drop, but it doesn't. Instead, he sort of perks up and says, "Well, that's fine. Bill, I want you to meet Mr. Smaltz of the Edison Power Co. Mr. Smaltz has bin tellin' me how much money we can save by buyin' their electric power and he is going to take our engine off our hands without chargin' us anything extra. I signed the contrak yesterday while you was at the power conference. 'Course, we'll need a janitor and I was going to give you the job but since you're going to Washington, you won't need it."

Boy, Power Conferences is great!

SELECTING THE RIGHT PUMP FOR THE JOB

By PAUL C. ZIEMKE

WITH A WIDE variety of pumps available these days it is the smart man who does a bit of shrewd marketing when out to purchase that new pump. A unit selected to suit the peculiar needs of the installation will render long years of service and at a minimum of upkeep cost.

In addition to lakes, creeks or rivers, cisterns or wells, we have the artesian type well where the water must still be pumped the final several feet to bring it to surface or the standpipe. One of the important considerations is the depth at which the water is located and the so-called "draw down" which means the mean level to which the water will lower when pumped steadily. To lower a draw down will hamper the pump efficiency seriously since the best performance is above 22 ft.

Shallow well pumps are to be found in the centrifugal and reciprocating models. For the small installation the reciprocator with outboard motor and V belt drive will serve nicely, yet for the larger installations the centrifugal unit will be most acceptable. With the latter no belts or reciprocating parts are required since the motor couples directly to the pump and drives it at motor speed which is usually 1750 rpm. The only moving parts then are the motor rotor and the pump impeller. Both of which are well-nigh indestructible.

Either float switches in the standpipe, or pressure type mercury switches control these pumps day in and day out with never a bit of care other than the placing of a few drops of oil or the cleaning of a blackened contact.

The next class is the jet pump which handles wells from 20 to 100 ft or better in depth. The jet pump is really a centrifugal pump. It only differs in the respect that a jet has been added so that it can function at depths beyond the reach of mere suction alone. The jet is submerged and connected to the pump with a double pipe line. The extra pipe is required in order to carry the high pressure stream of water from the pump and which picks up additional water at the jet and returns it to the pump over the other pipe. Various jets are available for the best efficiency at different depths. The jet pump can be used at a shallow well as an outside mounting jet can be had for driven wells or low pressure jets for the cistern or dug type wells.

For depths beyond the reach of a jet pump a deep well head will be the only choice. Unlike the previously mentioned pumps, this unit must be mounted directly over the well. The head supplies the motion to the cylinder at the bottom of the casing through a rod which links them together. A shelter is required to protect the head from weather and freezing.

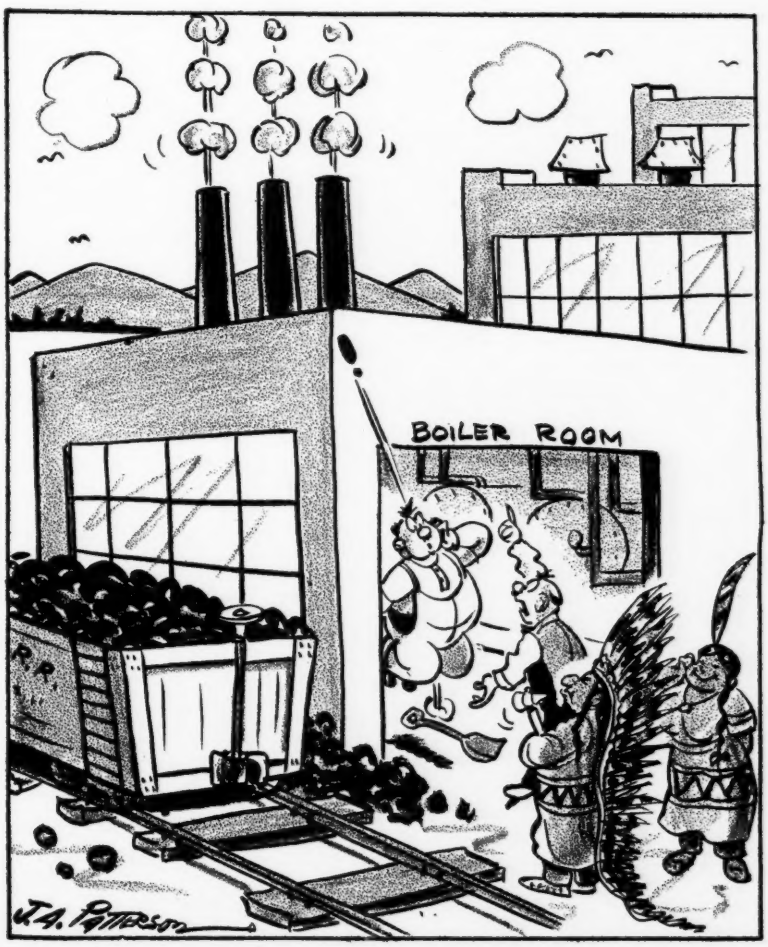
Now to determine the proper capacity of pump required. It is not a good practice to estimate too low and outgrow the pump. You will be installing modern bathroom, kitchen and laundry equipment that will require additional capacity. A larger pump will require the bigger investment but it will not have to operate as much to fill the tank with water, consequently insuring a longer life and plenty of reserve for fire protection.

The average daily requirement per person is 40 gal; each milk cow, 25 gal; each dry cow or steer, 12 gal; each horse, 10 gal; every 100 chickens, 10 gal; each hog, 3 gal; each sheep, 1½ gal. Sprinkling with a ½ in. hose requires 200 gal per hr; ¾ in. hose, 300 gal per hr.

With this information you can estimate your water requirement for a 24 hour period. Unfortunately, this demand does not occur at a steady rate, instead, water is required at peak periods which average up to about 4 hours. Therefore, divide your total daily need by 4 in order to find the pump capacity required in gallons per hour. For example, you use 1400 gallons per day, you will need a pump of at least 350 gallons per hour capacity.

PREFABRICATED CHIMNEY

PREFABRICATED CHIMNEY made of pre-cast circular sections of 2 ft lengths consists of a 7 in. chimney-tile liner surrounded by a 3 in. thick wall of masonry-type insulation. The assembly includes a ceiling or foundation support, the required number of sections, and a housing at the roof. Sections are joined by high-temperature chimney cement. Clamps at each joint make the structure monolithic when installed. One unclamped top joint provides relief in the event of settling of the supporting structure. The chimney may be installed in two-story structures. The chimney has been found to be free from fire hazards.



"The Chief here wants to know when the wedding will be—he says you been proposing to his daughter with smoke signals."

Mechanical Erosion of Thermometer Stems

A practical discussion of methods for overcoming erosion of metal thermometer stems and wells

By A. H. LAMB, Chief, Relay & Thermometer Engineering Div., Weston Electrical Instrument Corp.

THE MECHANICAL EROSION of thermometer stems, thermowells and protective sockets by the impact of solid particles conveyed by air blast or suction is a particularly troublesome problem in many plants, but one which can be readily overcome by fairly simple means.

When one considers the similarity between air blast conveying systems and the familiar sand or grit blasting where the intention is to provide a controlled abrasion to clean surfaces or otherwise prepare them for subsequent operation, it becomes apparent that the same type of erosion can be anticipated. Erosion caused by particles in the air blast conveying system is continuous and uncontrolled and may cause considerable damage before detection. While ducts of such systems are generally designed with this problem in mind, the accessories such as thermometers are necessarily designed for the primary function temperature measurement, and must be protected against mechanical erosion by some means of installation designed to minimize the effect of such abrasion.

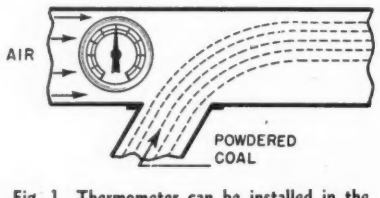


Fig. 1. Thermometer can be installed in the heated air stream just before the powdered coal is injected

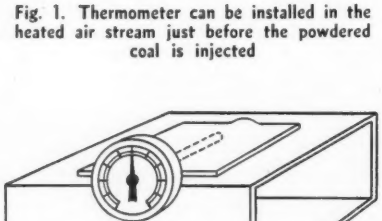


Fig. 2. Using the thermometer to indicate surface temperature

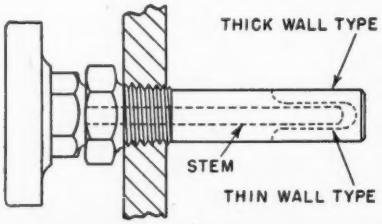


Fig. 3. Sketch showing the use of the thermometer with a protective socket

Powdered Materials Most Troublesome

Of the various pulverized or powdered materials such as coal, coke, lime, cement and similar substances handled and moved by suction or blowing, and of which temperature determination is of importance, pulverized coal and coke are by far the most troublesome.

It is common practice to preheat the air and powdered coal mixture before its entrance into the combustion chamber by admitting heated air into the conveying ducts. The mixture is maintained at a temperature of 275 to 300 F or thereabouts, but generally not above 350 F because of the danger of pre-ignition which might blow out or severely damage part of the furnace.

The correct operation of the thermometer is, therefore, very important, even critical, so that it behooves the operator to see that it is installed properly for permanently accurate temperature indication. The only damaging influence encountered in this type of installation is the eroding action of the powdered coal as it hits the stem or socket. If placed directly in the stream of powdered coal, the wall of a stem may wear away completely in a few days, a regular socket in a few weeks and a heavy-duty socket may last six months to a year or two. Since the destruction is one of pure mechanical abrasion and tear and certainly not of thermometry, the solution is one of simple mechanics.

Solution to the Eroding Problem

The best solution where applicable is to place the thermometer stem or socket where it will not contact the coal particles in the heated air stream just before the powdered coal is injected into the furnace. This is shown in Fig. 1. Next best from the accuracy as a surface thermometer outside of the housing as shown in Fig. 2. By attaching the thermometer in such a manner that the stem rests against the outside metal surface and covering with a patch of insulation, the thermometer

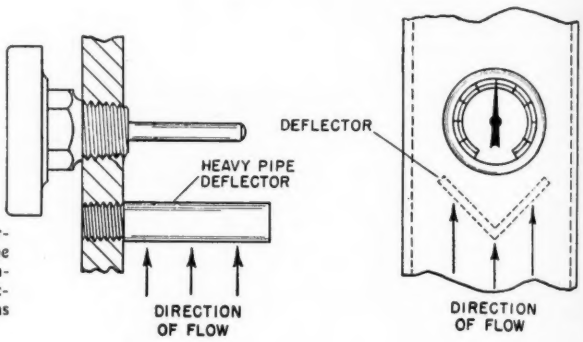


Fig. 4. If the thermometer can not be moved it is recommended that deflectors be installed as shown

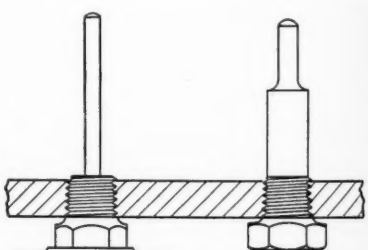


Fig. 5. This sketch illustrates the use of the thermometer with and without its protective socket

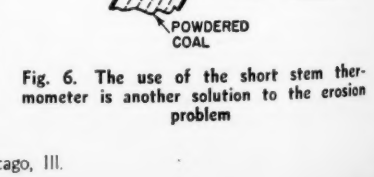


Fig. 6. The use of the short stem thermometer is another solution to the erosion problem

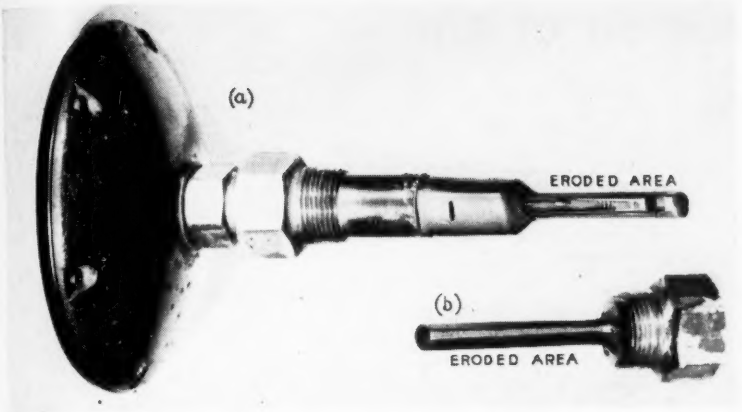


Fig. 7. Photograph illustrating the effects of improper installation of an industrial thermometer (a) and a smaller socket similarly eroded (b)

will indicate skin or surface temperature which in most cases will be within a few degrees of actual powdered coal temperature. If for some physical reason the thermometer must be placed where the stem will be in direct contact with the powdered coal, certain minor variations in adapting the thermometer may alleviate the erosion. A heavy-duty thick-walled socket may be used or a suitable baffle or deflector can be installed. This is shown in Figs. 3 and 4. The socket or thermal well need be used only if it is desired to be able to remove the thermometer without leaving the resulting opening. This is shown in Fig. 5.

In some installations the use of a short steam thermometer has given very good results in retarding erosion by keeping the stem out of the direct flow of coal. Figure 6 shows the installation of such a short-stem thermometer.

One or more of the above schemes should afford adequate protection for the thermometer against erosion and also against larger stray pieces of coal, slate, iron, etc. and in the long run maintenance costs will be reduced. But more important, the thermometer will be permitted to perform its intended function to measure temperature correctly and accurately and to protect life, property and profits.

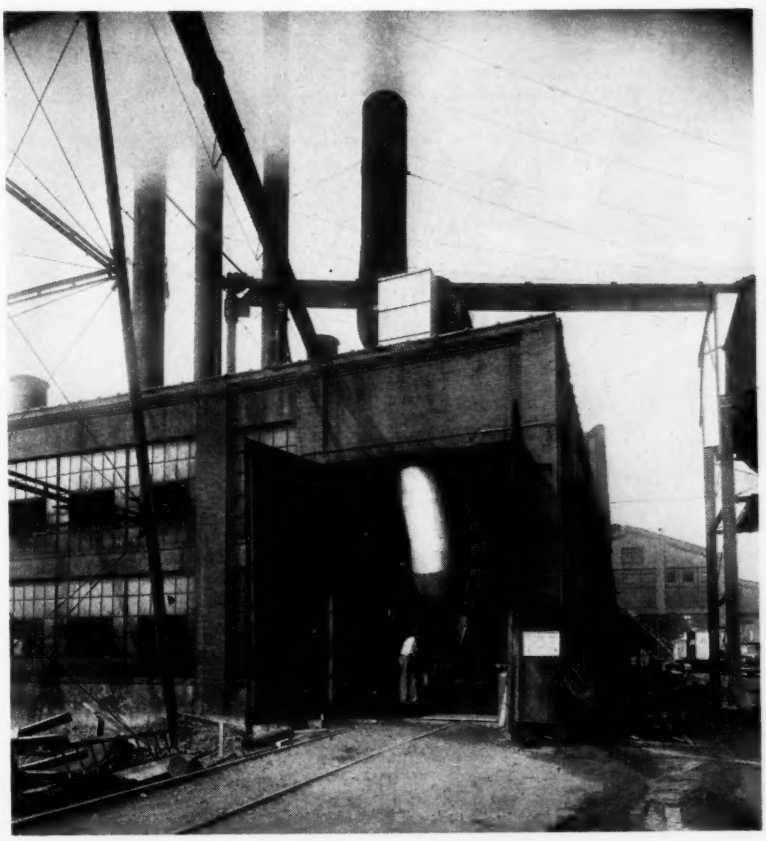
INDUCED DRAFT USED ON STANDBY LOCOMOTIVE BOILER

WHEN THE ELLIOTT COMPANY at Jeannette, Pa., decided to modernize its boiler house, the problem of standby or emergency boiler capacity during the changeover from old to new boilers was solved by leasing an old locomotive from the Pennsylvania Railroad. The picture shows how the locomotive was backed into the boiler house along side three old hand-fired boilers where it is easily taken care of by the firemen. To get better results from the locomotive boiler, the induced-draft fan from the first old boiler which was removed was placed on the roof of the boiler house and connected up to the front end of the locomotive as shown.

In addition to the generation of a part of the electric power requirements of the plant, the Elliott Company boiler house furnishes steam for the testing of turbines, blowers, steam jet ejectors and turbochargers. This testing requires large quantities of steam at irregular and unpredictable intervals.

The two modern boilers being installed, rated capacity 140,000 lb per hr, will generate steam at 650 psi, 825 F. Pressure-reducing valve and desuperheater stations on the test floor will give the required wide range of steam conditions below the constant boiler operating conditions.

Boilers will be equipped with spreader type stokers to burn local, medium-quality, fine bituminous coal. Related equipment includes new economizers, Venturi stacks, coal and ash handling apparatus, coal bunkers, dust collectors, automatic control, feedwater conditioning and heating equipment. Included is an Elliott deaerating feedwater heater, an Elliott desuperheater, and Elliott motors and turbines for driving the boiler-feed pumps and the forced- and induced-draft fans. Two Elliott 300-hp motors will drive compressors which are being installed along side the new boilers.



View at the boiler plant at the Elliott Co. at Jeannette, Pa., showing the locomotive used as an emergency boiler and equipped with an induced draft fan

Practical Application of the Mollier Diagram--IV

Characteristic diagrams of 2 and 3 circuit regenerative water cycles . . . Practical examples of a 100 per cent thermal efficiency cycles . . . Examples of a 100 per cent thermal efficiency cycle

By WALTER HEIDECKER

THE RANKINE cycle, usually taken as the ideal for the production of steam power, is not the most efficient method of turning heat energy into mechanical energy. Only a part of the heat that is added in the boiler can be converted to mechanical energy and thus be called available energy. The heat which brings the water to the boiling point (heat of the liquid) of course, can not be converted to mechanical energy and is unavailable.

A common approach to the problem of increasing thermal efficiency was to increase the superheat. Exactly the same result may be obtained in the percentage figure representing efficiency by decreasing the heat added in the boiler as "heat of the liquid." This can be accomplished by adding the heat to the feedwater before it enters the boiler, the source of the heat being partially expanded steam which is condensed in a heater, the feedwater being the coolant. It is desirable to use wet or saturated steam for this purpose otherwise we would be wasting our available heat energy for feedwater heating.

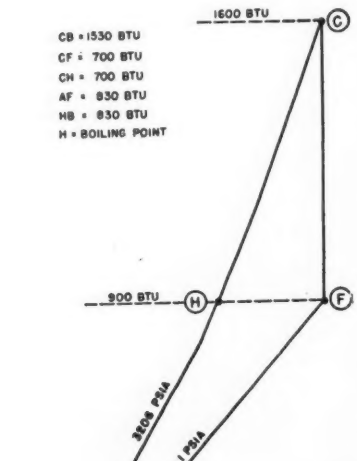


Fig. 1. Characteristic diagram of the Rankine cycle of a power plant generating steam at 3206 psia, temperature of 1230 F

To further illustrate these principles, Fig. 1 is the characteristic diagram of the Rankine cycle of a power plant generating steam at 3206 psia and at a temperature of 1230 F. The Rankine cycle efficiency is about 46 per cent. Less than half of the heat "BC" is available for conversion to mechanical energy. Increasing the initial pressure also increases the unavailable heat "BH." Now if "BH" (heat of the liquid) could be recovered from "AF" and could be added to the feedwater before it entered the boiler, the thermal efficiency of the cycle would be CF + CH which would be 100 per cent.

A More Practical Example

Some readers might like a more practical example of a 100 per cent thermal efficiency cycle. Fig. 2A is a diagram of a power plant in which the steam flow is divided at "C," 10 per cent passing through a small auxiliary turbine after which it exhausts into an auxiliary condenser (heater) the coolant being the feedwater. Fig. 2B is the cycle diagram and Fig. 2C is the flow diagram from which the combined efficiency of both turbines is calculated. The shaded areas indicate the heat that is returned to the boiler, the lower one being the heat of the liquid in the condensate and the upper one being the total heat in the exhaust steam of the auxiliary turbine.

The cycle upon which the auxiliary turbine operates fulfills all of the conditions of 100 per cent thermal efficiency outlined in the previous example. Although the auxiliary turbine may have an engine efficiency of only 50 per cent, neglecting small losses, its thermal efficiency is still 100 per cent as all of the heat not converted to mechanical energy is returned to the boiler. Of course, the main turbine operates upon the Rankine cycle. Combining the efficiency of the two cycles in the flow diagram, Fig. 2C, we have 253 Btu (total heat converted to mechanical energy) ÷ 1117 Btu (total heat transferred to feedwater in boiler) = 22.65 per cent.

If the auxiliary turbine exhausted into the main condenser, the combined thermal efficiency would be 253 Btu ÷ 1230 Btu = 20.57 per cent. As the saturation temperature is 397 F (boiling point at 240 psi) it would be logical to heat the feedwater to about 380 F before it enters the boiler. The reason why this is not done in commercial installations is explained by referring to Fig. 2A. Note that the feedwater, before entering the boiler, passes through a flue gas heater recovering heat from the flue gas, heat that would otherwise have to be charged against the power plant as a total loss. Due to the saving in waste heat and the resultant increase of boiler efficiency, this heater is known as an "economizer." It also acts as a stabilizer; when the feedwater is cold more heat is transferred from the flue gas decreasing the stack gas temperature. When the feedwater is hot less heat is transferred from the flue gas due to the lowered temperature differential between the flue gas and the feedwater.

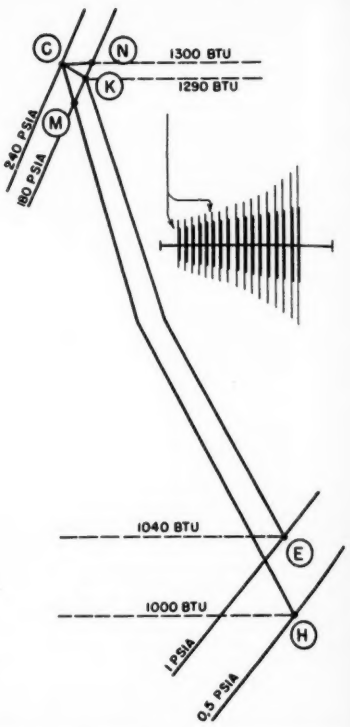


Fig. 4. This diagram shows how the admission of steam at some point other than the first row of nozzles changes the condition line of the turbine

Progressive Feedwater Heating

To secure maximum efficiency the feedwater should be heated progressively. This requires a heater for about every 70 F increase in the feedwater temperature. Turbine designers solved this problem by tapping the main turbine casing at regular intervals and extracting steam for the heaters. Electric motor drives were substituted for the small turbines as they required less attendance. The use of the small turbine was justified only when it acted as a pressure reducing valve delivering steam at a required lower pressure not supplied by the main turbine.

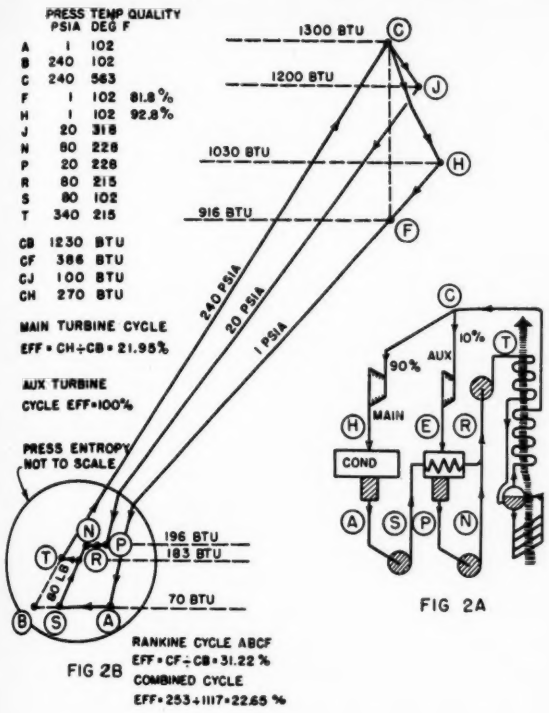


FIG 2B

FIG 2A

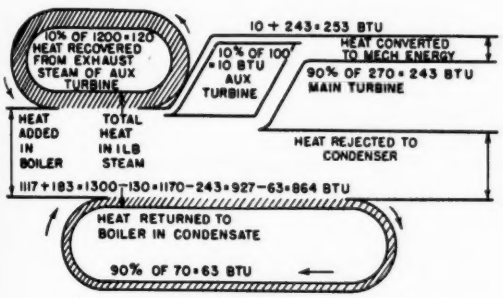

10% OF 1200 = 120
HEAT RECOVERED FROM EXHAUST STEAM OF AUX TURBINE
10 + 243 = 253 BTU
10% OF 100 = 10 BTU AUX TURBINE
HEAT CONVERTED TO MECH ENERGY
90% OF 270 = 243 BTU MAIN TURBINE
HEAT ADDED IN BOILER
TOTAL HEAT IN 1 LB STEAM
HEAT REJECTED TO CONDENSER
1117 + 183 = 1300 − 130 = 1170 − 243 = 927 − 63 = 864 BTU
HEAT RETURNED TO BOILER IN CONDENSATE
90% OF 70 = 63 BTU

FIG 2C

Fig. 2. A, B and C represent the practical example of a 100 per cent thermal efficiency cycle

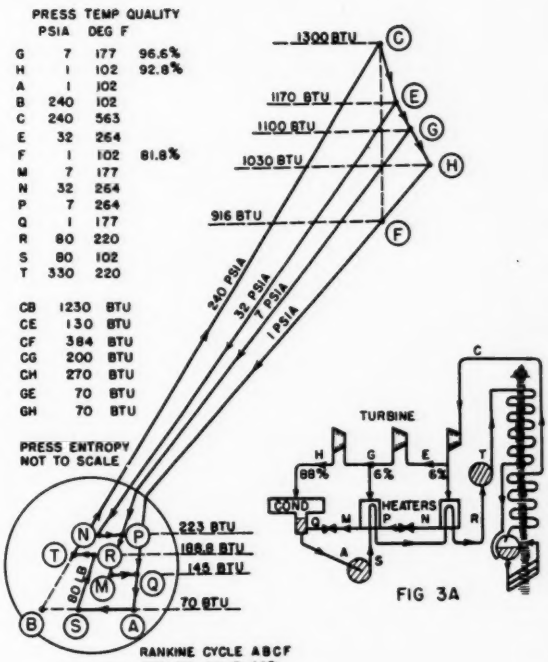


FIG 3B

FIG 3A

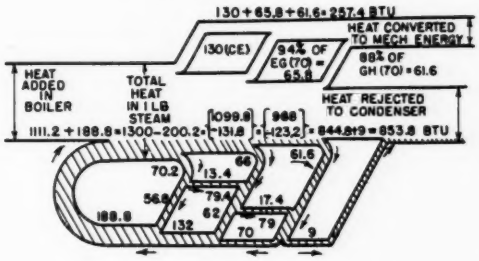


FIG 3C

Fig. 3. Diagram of a power plant operating on a 3 circuit cycle. The turbine has two extraction points

Fig. 3A is a diagram of a power plant operating on a 3 circuit cycle. The turbine has 2 extraction points supplying steam at 32 psia and 7 psia to the feedwater heaters. The condensed steam drains back to the hotwell entering below the water level, boiling the condensate at 102 F. The heat drop in the drainage "QA" (Fig. 3B) is lost to the condenser and must be subtracted from the total heat contained in the extracted steam. The method of constructing the flow diagram is simple. The turbine is divided into three sections (Fig. 3A) all of the steam at "C" passing through the No. 1 section to "E." The heat converted to mechanical energy and the heat extracted to the heater is subtracted and the remainder passes on to the second section. This procedure continues regardless of the number of sections until the steam is exhausted into the main condenser. Note that 12 per cent of the steam passing through the heaters operates upon two 100 per cent efficiency cycles and the remaining 88 per cent passes through all of the turbine which is operating upon a Rankine cycle. The overall thermal efficiency can be calculated from the flow diagram, Fig. 3C—257.4 Btu ÷ 1111.2 Btu = 23.18 per cent.

The operator of a steam power plant generating electrical energy to be used for power and light is compelled by law to carry whatever load the public demands. To meet these peaks occurring on dark days, etc., the turbines are equipped with overload connections. This is an added throttle valve admitting header steam to the turbine at some point other than the first row of nozzles, usually the fifth or sixth.

This admission of steam changes the condition line of the turbine (Fig. 4). "CKE" is the condition line with the overload connection open. "CN" represents the throttling of the steam of the overload connection. "MK" represents reheat added to the steam entering at "C."

"CK" is the condition line of the bypassed row of nozzles and "KE" is the condition line from the overload connection to the exhaust.

A NEW LAW in the State of Pennsylvania prohibits producers, dealers or others from representing anthracite fuel as standard anthracite unless it conforms to standard specifications fixed by law. Maximum penalties which include fines and imprisonment are stipulated for offenders. The law applies to anthracite "sold, resold, shipped, delivered or marketed". The standard specifications for buckwheat, rice and barley are the same as those published in the Coal Data section of the SMA Technical Manual.

The Causes of Knocks in Duplex Feedwater Pumps

This problem is interesting because it deals with the dynamics of fluids and a machine in motion, and vanishes whenever the machine comes to rest. Types of knocks, mechanical knocks, vapor knocks

By GEORGE HOLMAN

Ed. Note: Sometimes a question in the Q & A Section arouses so much interest, because it applies to so many plants, that some one is prompted to write an article attempting to cover the problem completely.

THE CAUSES of knocks in a duplex hot water pump fall into two natural classes, mechanical knocks and fluid knocks. Mechanical knocks are caused by misfitting or maladjusted pump parts. Except for the hammer of water when reversing its direction of flow, found usually when the air chamber has lost its air cushion, or in pumps having no air chamber, fluid knocks are vapor knocks. They include those caused by air entering the suction pipe, as well as those due to vapor evolved from the liquid. Vapor knocks may be traced to faults in installation, design, or repair, and to the conditions under which the pump must operate.

The impact which gives rise to an audible knock may be metal against metal, metal against water, or water against water. Although it is a very active agent in the causes of knocks, the elastic nature of vapor prevents it from being a direct agent in actual impact. It supplants liquid in the cylinder, however, and causes the pump to knock by sudden release of load on the moving piston or plunger. Knocks traceable to air or other gases entrained in the water occur even when the water is cold. But knocks due to evolved vapor happen only when the water being pumped is warm.

A. Mechanical Knocks.

Common knocks of a purely mechanical nature, distinct from the action of any vapor, have the following causes:

1. Steam piston striking head or rod end of cylinder, due to rod being too long, or to piston misset on rod.
2. Plunger striking head or rod end of cylinder (inside packed), water piston striking head or rod end of cylinder (piston-type pump), or plunger striking web between cylinder compartments (outside packed).
3. Rod nut loose and striking steam cylinder head or water cylinder head.
4. Steam piston, water piston, or plunger loose on rod or yoke.
5. Worn steam cylinder, with piston ring striking ridge at end of piston travel. This may occur where no overtravel of rings into the clearance space has been allowed for, or where clearance has been eliminated by deep reboring of cylinder.
6. Packing too tight on unevenly worn water piston, plunger, or rod, and with water cylinder, plunger, or rod worn unevenly. Friction restrains movement when larger diameter passes through packing. Free slippage of the smaller diameter part through the packing causes the impact and knock.
7. Water slippage past loosely packed piston or inside packed plunger.
8. Loss of discharge head, as by a broken discharge line.
9. Suction valve sticking open or leaking badly. This has the same effect as loss of head. The water flows back into the suction pipe, and does nothing to load the piston and keep it from striking the head.
10. Pump speed too great.

B. Vapor Knocks.

If the pump is above the source of supply, vapor knocking when pumping hot water commonly occurs. The following are common causes:

1. Negative suction head (lift) too great for the temperature of the water being pumped. Conversely.
2. Water temperature too high for height of lift. The lower the temperature of the water, the higher the suction stroke of the pump can lift it. Assuming sea level atmospheric barometer reading of 30 inches of mer-

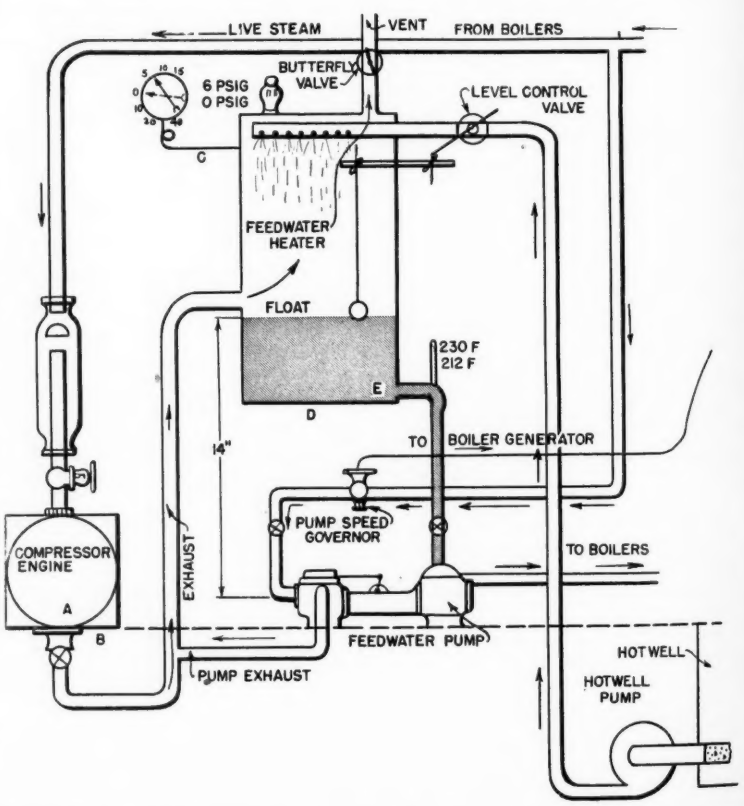


Fig. 1. How a vapor knock can occur with positive suction head and pressure in the supply vessel

A. Engine driving a compressor drops load.
B. Much less exhaust steam is discharged from engine.
C. With only a fraction of normal exhaust steam entering it, the pressure in the heater, at constant butterfly valve setting, falls from 6 psig to zero gauge.
D. With drop in total pressure upon it, the feedwater cools itself from 230 F to 212 F by flashing part of water into vapor.
E. This vapor evolved from hot water by pressure drop appears first as millions of tiny bubbles in suspension in the water of the heater and in the suction pipe to the pump. These move to the surface of the water in the heater. Those in the water in the suction pipe, however, form larger vapor pockets which are carried into the pump, and cause it to knock.
F. By loss of exhaust steam pressure in the heater, pressure at pump inlet falls from 12 psig (.43 x 14 plus 6 psig) to 6 psig (.43 x 14).

cury, no friction in the suction pipe or valve ports, no weight of suction valves and no spring tension on them, and no entrained gases in the liquid, very cold water may be lifted a theoretical maximum of 34 feet. This varies downward to zero feet for water at 212 F.

If any attempt is made to draw boiling water up a suction pipe above the level of its surface, the pipe fills with the vapor the water gives off. Since this vapor is at a pressure almost as high as that of the atmosphere, no vacuum can be created. The pressure of the atmosphere on the surface of the liquid cannot force the water upward into the pipe against the equal pressure of the vapor already there.

3. Elevation of the installation above sea level. As the distance above sea level increases, the pressure of the atmosphere decreases. This reduces the theoretical lift of cold water much below 34 feet. For hot water the possible lift it very much less.

4. Fall in barometer. If a pump installation can just raise water of a given temperature the required distance without knocking, any fall in the barometric pressure may cause the pump to knock. Since the lift is usually invariable, knocking caused by atmospheric pressure drop can be stopped only by lowering the water temperature.

As will be shown later, the following causes of vapor knocking may be present even if the source of supply is at the same level, or situated above the pump. They are especially important, however, if the suction head is negative:

5. Suction pipe, or section of it, too small for capacity, or demand by the pump. The amount of vapor formed from water of a given temperature depends upon the pressure, or lack of it, in the cylinder, not the supply vessel. Any appreciable pressure drop in the suction pipe may result in excessive vapor formation from hot water.

6. Partly throttled suction line valve. This produces pressure drop in the same manner as the line being too small. On passage from the higher pressure above the valve to the lower pressure below it, flash vapor will form from very hot water.

7. Obstruction in suction pipe. This causes pressure drop, and consequent vapor formation, in the same manner as a throttled valve.

8. End of suction line not submerged deeply enough in the supply. Eddies form over the intake, and carry air into the suction pipe through their vortices. Large quantities of air act much like vapor.

9. Inleakage of air into the suction pipe at joints, valve stem packing, etc. This is possible with the supply higher than the pump, as when speed of pump is great or when pressure drop causes parts of the suction stream to fall below atmospheric pressure. However, it is probable only when the supply is lower than the pump.

10. Suction valve orifice too small for pump capacity. This is the equivalent of an obstruction in the suction line.

11. Suction valve not opening fully. This permits moving plunger or piston to form high vacuum behind it at start of stroke, with high vapor release from hot water in the cylinder. On the return stroke the plunger or piston may move too rapidly through the elastic vapor and strike the still moving water. The impact may cause a sharp knock.

12. Suction valve springs too strong, with formation of high vacuum behind plunger before valve opens. Results as above.

The following causes of vapor knocks may be found at the supply vessel:

13. Supply vessel not suitably vented. The vessel may become vapor bound. A too small vent produces the effect of lowering the source of supply. If the vent is absent, the pressure of vapor evolved from the liquid, or supplied from a separate source, must supplant atmospheric pressure in moving the liquid to the pump.

14. Fall in pressure of the vapor on the water supply. This may act to cause vapor knocking, especially if the supply is kept normally under pressure above atmospheric, and the temperature of the water above 212 F.

Analysis of these causes of vapor knocking show that Nos. 5, 6, 7, 10, 11, & 12 are due to pressure drop between the supply and the pump. They may be lumped together as restricted flow. Like the intake of air into the suction pipe, restricted flow can cause knocks due to vapor evolution, regardless of the relative positions of pump and supply. If great enough, pressure drop may offset a positive suction head.

Figure 1, shows how a combination of factors, such as restricted flow and a fall in pressure on the supply, may cause vapor knocking, although the supply is above the pump and has a plenum above it. The installation is common. The boilers are fed by a duplex pump, and the feedwater is raised by a centrifugal pump from the hotwell to an "open" heater. Water is heated by an engine driving an air compressor. The pressure in the heater is governed by a manually operated butterfly valve.

When heavily loaded, the engine gives off large quantities of exhaust steam, all of which must pass through the heater. With the outlet partly closed by the butterfly valve, a pressure of 6 psig builds up in the heater. This is shown by the rise in the feedwater temperature to 230 F, a temperature of the water impossible of attainment at atmospheric pressure.

During normal operation under load there is no vapor knock at the pump and no vapor formation, because the pressure in the heater adds another 14 feet to the positive suction head of the water. When the load on the engine falls, there is much less exhaust. If the setting of the butterfly valve remains constant in throttling position, the pressure in the heater falls almost instantly.

Since the exhaust steam pressure in the heater extends downward as far as the pump cylinders, its disappearance results promptly in the evolution of large quantities of vapor from the momentarily superheated water, and the water temperature falls to that corresponding with the steam pressure upon it, plus head pressure. It is this pressure drop, not the temperature drop instantly following it, which causes knocking due to the presence of the evolved vapor.

The knocking of the pump by such evolved vapor may continue until the water cools and the vapor condenses by heat loss to the air or surroundings, or until the vapor in the suction pipe is carried through the pump by the cooler water from the heater. From this cooler water less vapor evolves, and the pump ceases to knock.

This trouble can be eliminated in several ways. Keeping the feedwater temperature low is effective. If high temperature water is desirable, the butterfly valve should be closed more when the supply of exhaust steam falls, and reopened when the supply increases.

Some non-mechanical pump knocks have their origin at the steam valves. Also, water in the steam supply can cause a knock in a pump, especially if the pump is operating at high speed, or the exhaust line is restricted.

WITH A NEW feed heat dried to a surface moisture content of about 1½ per cent, coal sized to minus ⅜ in. size can be cleaned in electrostatic separators. Based upon laboratory tests, one plant is said to be able to clean a raw coal feed containing 12-13 per cent ash to approximately 4 per cent ash at the rate of 25 tons per hour.

A TURBINE HAS been developed to drive the fan of a unit heater. The steam first drives the turbine, then enters the radiator and is condensed before returning to the boiler through an open return system.

THE RESEARCH and development program for the gasification and liquefaction of bituminous coal undertaken by the Pittsburgh Consolidation Co. will include an oxygen plant as a part of the pilot plant to produce synthetic gas. Construction of the synthesis-gas plant is the first phase of the program to develop an economical method for converting coal to liquid and gaseous fuel by the Fisher-Tropsch method. In the pilot plant, finely ground coal will be converted to carbon monoxide and hydrogen using steam and oxygen. It is estimated that the pilot plant will cost $500,000.

Is This Why We Have a Lumber Shortage?

Again Mr. Brown reaches into his book of memories and comes up with this tale of the hapless Joe who worked against great odds for small wages and no thanks. Virtue triumphs in the end, however, so be patient with the over-patient Joe and hiss the villain all you wish

By R. L. BROWN

SOMETIMES, it so happens, that after a man has given a company all of the knowledge that he can possibly obtain through years of experience and hard study, the reward he gets is very small indeed. Also, this same man, because he is willing and ambitious, often has the heaviest burden to bear. This is the story of such a man.

It happened a good many years ago, 'way back there in the twenties. This fellow—let's call him Joe—was a young man when he first went to work for this particular lumber company.

Joe knew very little about steam power plants, in those days, but he landed a job in the boiler room at this sawmill plant as combination watchman and fireman.

This mill was an ordinary-sized mill of about 85 thousand ft capacity in ten hours. The fireman had to work from six until six—twelve hours—but he got mill time, ten hours only. If the fireman didn't like the way the company was treating him he was at liberty to find another job.

Joe was a hard working kid and the management was quick to catch on. Whenever there was any extra work to be done out at the plant at night, such as helping the engineer or the millwright, they told Joe to hurry up and get his fires in good shape so that he could be of some help to the mechanics. And, of course, Joe being full of ambition and willing to learn hopped to it.

He learned fast and when the day fireman quit, Joe was put on days. After Joe had been firing days for a while he began to get the idea that there were a lot of things that could be done to improve the power situation, as the steam was hard to hold.

For one thing, there were leaks everywhere all over the plant and very little insulation on any of the steam piping. Then there were the green slabs taken right from the saw, directly to the boiler room. One day Joe suggested to the chief engineer that something be done about this. The old chief hit the ceiling as he felt that his was one of the best-managed power plants in that section of the country.

Then there was the underground steam line leading to the planing mill. It had no insulation on it; it was just laid in the cold ground and in the winter the water stood over the pipe several inches deep. There were always puddles of hot water along the pipe line and several men were unforunate enough to step into this hot water bath and were scalded. When the steam (what was left of it) reached the planing mill it was pretty poor grade so far as the efficiency of the engine was concerned.

The company had an old Atlas slide valve to run the planing mill and what the wet steam did to the valve seats on this engine was a sight. There wasn't any expansion loop in this line either, so every joint of pipe was leaking and the pipe line was 300 feet long. It is no wonder Joe became discouraged and felt that he was working for a lost cause.

Along about two years later the old company that owned the sawmill and planing mill sold out to a company from Louisiana and this concern brought most of their men with them, including the Negroes who they thought would work for small wages.

They were later to learn a good many lessons. The first order of the day was to cut the wages. Joe being pretty well fed up on the way the boiler plant was run asked for his time, as did a good many of the others that had worked for the old outfit. This was just what the new management wanted at that time. Now they could put the Negroes to work for 20 cents an hour, as common labor.

However, the Negroes soon fooled them. Just as soon as they got money enough to travel on they took off for parts unknown, so this exploitation of the Negroes didn't work so well.

It was hardly a week after Joe lost his new job due to a fire that he heard about his old concern wanting a chief engineer. So Joe goes down there to see about the situation. Things hadn't changed much but they were short of men and they also had a new set of bosses. So Joe hired out for the job that was later to become a nightmare.

It was long hours those days and the engineers were hired by the month. This meant as many hours as a man could stand on his feet.

Due to the rundown condition of this plant, Joe had his nose to the grindstone. This was his first job as chief so he had to make good no matter how great the handicaps.

This power plant was in such a rundown condition that Joe had a lot of night and Sunday work. This work continued for about two years and by that time Joe had begun to make a showing. At least he had cut down on some of the steam leaks.

However, it was next to impossible to convince the company that he needed some spare parts for his pumps. In fact, he needed a couple of new pumps, as the ones in operation at that time were over 20 years old and had been broken many times. They were strapped together with rods and 1 in. by 6 in. iron plates across each end. The valve decks were not much better with the threads stripped in the seats. The steam end of these pumps looked like the Sahara Desert sand dunes with many ripples and creases cut from 20 years of misuse.

This was the situation that confronted the young chief engineer just before the shut-down came in 1931.

The management of the company was kind to Joe and offered him a job as bull-cook around the plant while it was down. However, there were times that they would have Joe get up steam to operate the planing mill during those three years. Lumber moved pretty slow those days as did everything else. Joe was fortunate, in a way, to have a job but he earned the money they paid him. He did everything from taking care of the domestic water system and firing the boiler when necessary to punching the watchman's clock every two hours. Joe was a busy man.

The depression came to an end eventually and the company made plans to start operation once again, after their three year shut-down.

This was in the spring of 1934. Some changes had also been made in the company management during those three years. When the new boss arrived he immediately took charge and he wasn't long in making the men know that he was a great man.

Now here was our young chief with four old fire-tube boilers, an old steam engine belted generator that came over on the Mayflower, three worn-out pumps and 90 per cent of the other auxiliaries in the same shape.

The manager called Joe into his office one day and advised him that beginning immediately the company was going to expand operations. They were going to add a box factory to the planing mill, also a dry sorter shed. The factory demand for power being in the neighborhood of 300 bhp and the dry sorter 50 hp, Joe told the manager that he would need a couple of new boilers or a water-tube boiler of about 400 bhp. The manager hit the roof. He said they had neither time nor money to install a boiler and that they would have to make sufficient power with the existing four boilers.

The new foreman was also at the conference that day. He contradicted

Joe; he said he didn't know anything about steam power. Why, when he was boss in such-and-such a plant, they pulled two outfits with less power than they already had in this plant.

The foreman sure put the quietus on the new boiler and also put Joe behind the eight ball at the same time. Now Joe knew he was in for it. It was a case of make those old kettles pay off or else. So he went after repairs for the pumps and the auxiliaries. Here again he ran up against a blank wall. The manager had given the foreman charge of all repairs. Joe then tried to talk over the situation with the foreman but he was advised that there was already enough power available and all that he had to do was to get to work and clean the dirty place up. Also, see to it that everything was ready to go by the first of the month which was then two weeks away.

It took a couple of months before the factory was completed and it was then late summer before the load hit. The old boilers had been doing very nicely with the sawmill load and the planing mill load.

But the morning that they bolted the coupling together to operate the factory will go down in history in that town. The manager and some of the stockholders of the company were on hand that particular morning to witness the factory start-up.

The way that little Atlas 150 hp engine laid down was pitiful. It had never been intended to pull such an enormous load when it was manufactured. Of course, the first fellow that the manager went looking for was the chief engineer. He wanted to know what in hell was wrong with the engine as it didn't have power enough to turn the saws up to more than half speed. Joe simply repeated his story.

So they sent for a consulting engineer. Of course, this cost them money which made them all the more disguested and they were very much put out when the consulting engineer told them that they not only needed a new and larger engine but about 500 bhp. Moreover, in the boiler room the foreman and the consulting engineer nearly came to blows over the power situation.

The engine didn't improve any in its operation, so the foreman gave Joe orders to screw down the pops on all of the boilers to 150 psi, which was 15 lb more than the boiler inspector had allowed at his first inspection.

This little trick on the foreman's part didn't do any good as the fireman wasn't able to hold the steam to over 100 psi while the plant was in operation, anyway. The only time he ever got the boiler pressure up to 150 lb was at noon hour and before starting time. They were fortunate indeed that the boilers never blew up. It wasn't long before the inspector came up to investigate—it seems someone got wise and reported the situation.

So the management was right back where they started. The factory didn't do much operating the rest of the summer and fall.

During the winter shut-down the manager purchased an old 18 by 30 Corliss that had been through a fire. "Now," said the manager, "we have our problem solved." But, as in the past, he had never once asked Joe to assist him in selecting any of the units for the power plant. The only thing that he was interested in was that Joe get busy and make this old Corliss pay dividends.

The Corliss engine, being larger than the old Atlas, required a larger steam line. The Atlas had a 4 in. line which was buried in the ground without any insulation whatever and was 300 ft long.

After a lot of discussion Joe finally cornered the manager and foreman and stated that he needed an overload steam line from the power house to the factory for the 18 by 30 Corliss. Joe had asked them for a 7-in. line so as to have ample steam supply. They agreed until they found out what it was going to cost. Then the manager balked and said that as long as the old engine had a 4-in. line underground he could not see why a 5-in. line overhead wouldn't be just as good as a 7-in. line.

There wasn't any doubt but that the 5-in. line would carry the steam to the engine but not enough of it as the manager soon found out.

Sure thing, they started up full blast one Monday morning that spring—box factory, planing mill and sawmill, also the dry sorter shed engine. This small engine of 20 hp also had been installed during the winter shut-down. This engine had a 1½ in. feeder line underground; it was 400 ft long. There was very little steam at the end of the line; mostly hot water.

Did they run? No, not for long. As the 18 by 30 stayed hooked up from the first and it wasn't long until they ran out of steam.

There was another little trick that the foreman had thought up against Joe's wishes and this stunt didn't help the steam any. He had installed 9-ft grates under those old fire-tube boilers. This was a joke. The air instead of going through the fuel bed went around it.

They had a good many weeks of chaos before they began to listen to Joe. Finally they got him the pipe insulating material and the material to build a heater so as to utilize the exhaust steam to heat the boiler feedwater.

The foreman had bucked this heater for a long time as he figured that the ¾ in. live steam line going into the hot well was sufficient to heat the water. When Joe told him how much heat was lost he got mad.

With the pipe covered and the feedwater heated by exhaust steam, the plant ran a little more efficiently. But still there were those 9-ft grates with a shallow furnace 4-ft high. The sawdust would be running out the top and still the grates were not sufficiently covered.

Then came more trouble for Joe. The flues began to leak on all of the boilers and the manager just wouldn't buy boiler feedwater treatment. The foreman's method was to pour about five gallons of crude oil into the boilers while they were down for washing. This finally resulted in putting a peach of a blister on No. 1 boiler. Of course, the inspector was called in to see what could be done. When the foreman was told that it was caused by oil in the boiler, he hunted Joe up and told him in the presence of the inspector that he knew that too much oil was being put in the boiler and he had been telling Joe all along not to do it.

This incident soon was over and the boiler back on the line, but the boiler had to be boiled out with soda ash. Then the foreman took the inspector's advice and helped Joe get a suitable boiler feedwater treatment. But the damage had been done. There was so much accumulated scale on the boilers that the compound couldn't act to much advantage. Then again the flues were leaking on all of the boilers.

So once again they called in a consulting engineer and he told them that they had too much grate surface, also that there was too much scale and a lot of other things.

Shortly after this they patted Joe on the back and told him that they were going to reward him by placing him in charge of all their power; also give him an operating engineer whom he could choose. Previously Joe had been alone and working several hours after supper some nights as well as operating the engine at the sawmill all day.

The company also had another plant about 20 miles away, so Joe had charge of the power there too. All of this sounded big to Joe and he fell for it hook, line and sinker. But he soon found out that instead of being a chief engineer in charge of power, he also was the general maintenance man. The foreman still was his immediate superior so he had to take his orders from him. Then too, the foreman was burned up because the manager hadn't put him in charge of all the power.

The following winter the foreman told Joe that due to reverses the company had lost money. So the management wanted Joe to fire the boilers on one shift, preferably 4 p.m. to 12 midnight. This would give him time in between fires to tighten up on the bearings on the factory engine and also maintain the pumps and keep the sprinkler systems pumped up.

Joe liked the engineer job pretty well and being his first chief's job, he did this work for several winters. The management kept dragging along with their same old boilers, worn-out pumps, etc. However, they did retube all of the boilers one winter. Joe had to do this. They released him from the

XUM

fireman's job long enough for this. No more pay though.

Joe was pretty fair as a machinist and machine shop repair work too, having learned it by working overtime on his own in the machine shop without any pay.

The manager knew this too, so he gave Joe more duties to perform. The next summer he also had to work in the machine shop and do all types of repairing, besides keeping his power plants operating.

One day the manager offered him a job as welder and mechanic in the machine shop at slightly lower wages on an hourly basis. Now he was to do his work in the machine shop, also go over to the power house whenever they called him and do the new chief engineer's work.

The new chief happened to be a relative of the foreman's so it wasn't hard to figure everything out. The old machinist that quit hadn't had to do any of Joe's work while Joe was chief but then things were different now. Joe had no other choice but to quit or do the work. This he did for over two years.

In the end these kind of tactics usually catch up with a plant. Things began to get in a rundown condition. This infuriated the foreman because the manager was now pressing him for production. But, of course, the foreman's relatives couldn't cut the buck, especially the one that he had put in Joe's place as chief so the foreman called upon Joe more and more for help.

Joe got tired of this one day because the chief was making 20 dollars more a week than he was and Joe was having to do this work so he asked the manager for more money if he was to continue to do all of his work. In other words, he was now the master mechanic, but was classified as a blacksmith's helper in the company books.

"No more pay," says the manager. "You aren't worth it. Why the foreman is worked to death doing your work now." So Joe quit. And here the trouble began for the foreman.

This new man didn't know anything about a power plant. He was a machinist and welder only. Now it was the foreman's turn to really do something but he was doomed to failure, as he couldn't do it. Neither could his chief engineer.

About a year later the manager fired the foreman and all of his worthless relatives.

Joe's got a job with a concern that appreciates loyalty but the foreman is still trying to cover up for all of the mistakes he makes.

SPARKPROOF CABLE FOR COAL MINES

A NEW CABLE that will not spark when short circuited has been developed by electrical engineers to aid in prevention of coal mine explosions.

The new feature of the cable is a fine strand of copper wire embedded between the inner and outer layers of insulation. In the event of damage to the insulation the fine wire catches incipient current leakage before an arc can occur and carries it to a sensitive circuit breaker which cuts off the power.

The cable was developed jointly by engineers of United States Rubber Co. and Leonard Wilson of Kenilworth Mines of Utah. It is expected to eliminate a common source of danger in coal mines. This type of cable is used to carry power to heavy equipment employed in digging and transporting coal. The cable, trailing on the ground, is in constant danger of being damaged.

Questions And Answers

Question No. 396

HOW DO YOU DISCOVER IF THERE'S ELECTROLYTIC ACTION IN BOILER?

I HAVE BEEN a subscriber to POWER PLANT ENGINEERING for some time, and would like to ask you a question.

At our boiler plant here we have always had a pitting condition in our heating boilers. We have used a number of different boiler compounds with not too much success from any of them in controlling the pitting. The last company we did business with seemed to think that we have an electrolytic condition.

Can you give us any information as to whom we could consult in having our boilers grounded? And also do you know of any tests that will prove if an electrolytic action exists?

South Haven, Mich. M. H.

Question No. 397

COULD SPONTANEOUS IGNITION HAVE CAUSED THIS EXPLOSION?

IN ONE of our industrial plants, there was a serious explosion in an air compressor system recently. It looks to me as though it might have been caused by spontaneous ignition.

The explosion occurred in the steel piping and cast iron fittings in the system. The operating pressure was 400 psi, safety valves were set at 525 psi, but some of the ruptured cast fittings were stamped 300 lb pressure. The ruptured pipe and fittings were 1¼ and 1½ in. nominal pipe size.

Evidence of ignition causing the explosion is that the broken surfaces of the cast fittings, where small pieces were blown out, were very black, indicating that fire had passed over them. If they had merely been broken by excess air pressure, the fracture surfaces would have been clean and bright.

If you have any information about ignition and explosions of this type, I'd like to have it.

Wisconsin M. A. E.

Answer No. 367

WHY DOESN'T THIS CHIMNEY PRODUCE ENOUGH DRAFT?

A BRICK lining 18 in. thick in a 7-ft diameter by 80 ft high steel stack would cost at least $1000 and probably would not solve the difficulty since there appears to be some unexplained cause of draft loss.

There are numerous formulas based on a multiplicity of factors for figuring the diameter and height of a chimney but until we know the actual working conditions of L. H.'s chimney, we can only speculate. He states he is burning saw mill refuse under two HRT boilers with a possible total load of 250 boiler hp. Referring to Chapter 7, page 94, (February, 1946) of the Boiler Fireman's Handbook, I show how to calculate flue gas weights in conjunction with the proper curves and charts.

Assuming 60 per cent efficiency at a flue gas temperature of 600 F when burning wood waste, by reference to the curves on page 98, we obtain 12.5 per cent CO_2 or 63 per cent excess air. Next, referring to Table No. 5, page 95, we obtain 6.4 lb gas per lb of wood. The fuel consumption per hour is calculated as follows:

$$\text{Lb wood per boiler hp} = \frac{33{,}500}{\text{Btu} \times \%\ \text{Effic.}} = \frac{33{,}500}{5000 \times 0.60}$$

$$= 11.2 \text{ lb}$$

$$\text{Lb gas per hr} = 11.2 \times 250 \times 6.4 = 17{,}900$$

From Table V we find the density of the gas at 65 F = 0.0736.

$$\text{Density at 600 F} = \frac{525}{1060} \times 0.0736 = 0.0364.$$

$$\text{CFM} \quad \frac{\frac{17{,}900}{60}}{0.0364} = 8175$$

Area of 7 ft stack = 38.3 sq ft

$$\text{Velocity in ft per sec} \quad \frac{8175}{\frac{38.3}{60}} = 3.54$$

Although J. G. Mingle in his book, "Draft and Capacity of Chimneys," assumes an average velocity of 30 ft per second as being acceptable for certain average conditions, a velocity of 3.54 ft per second may not be too low, since velocity is only one of several factors in the functioning of a stack or chimney. As a matter of fact, the higher the velocity, the greater the draft loss due to friction. A velocity in the order of 30 ft per second is not necessarily the most efficient velocity although it may be an economical average. A lower velocity resulting from a larger diameter of stack might be more efficient but would cost more. The weight of the stack gases, the temperature of the gases and the height of the stack, are much more important factors.

At a temperature of 600 F leaving the breeching, the average temperature in the stack may be 500 F. With this temperature a stack 80 ft high will produce about 0.55 in water draft at the base of the stack. This should be sufficient to produce 250 boiler hp.

The fact that L. H. is unable to obtain enough draft to barely "pull a handkerchief in the asphit door" might indicate some undue resistance in the system such as a partially closed damper or clogged gas passages. But even if nothing of this sort is found, the cheapest solution to the problem would be the installation of a small induced draft fan which will give positive gas flow and is not subject to the vagaries of the wind. Such a fan can be purchased for about $250 exclusive of the motor and drive. The average cost of a 5 hp motor and V-belt drive will not be far in excess of $100 so that the total cost of a fan would be at least one-third that of a stack lining and the fan would give definite and positive results.

Dallas, Texas — J. R. DARNELL

Answer No. 374

WHAT ARE DUTIES OF WATCH ENGINEER, FIREMAN, OILER?

Definitions from Cunningham

WATCH ENGINEER — His duties are to check all operating equipment, in cooperation with the men under him on the watch. While the oiler is checking the engine bearings, the engineer must check the load on the generators by observing the meters on the switchboard. The changing-over of engines, pumps, motors, refrigerator equipment, the starting up or shutting down of any and all equipment, is the responsibility of the watch engineer. Carrying out orders left by the chief is another must, when and if it is possible to do so.

THE OILER—This man in the power plant is another pair of eyes for the engineer. It is his duty to report to the engineer any improper or undesirable operation of the equipment. The oiler must check before accepting or taking over the watch. The oiler feels all bearings on the main engine to make sure there is no overheating. He examines the lubricating devices and systems to make sure they are functioning. As lubricating oil lubricates better when hot than when cool, these lubricants must be at correct temperatures, thus the thermometers are checked and logged. On many bearings — especially on turbines — thermometers are installed. On water-cooled bearings there are also thermometers and the temperatures are checked on the inlet and discharge (water sides). This also applies to the thermometers on the condensers, steam and refrigeration (if both of these systems are in the plant). The oiler also checks on the temperatures and lubricators of feed pumps, condensate pumps, lubricating oil system, (pumps and cooling system), and all auxiliary machinery. The oiler will also check the electrical load on his round on watch and feel generators for any rise in temperature that might occur due to load or any other cause.

THE FIREMAN — The fireman must also check over before taking the watch over. Where there are several fireman on watch, each fireman will check on some piece of machinery and then all should check with each other to see that everything is all right before taking the watch over. The gage glasses and water columns are blown down to make sure they are operating properly and that the level is correct. If oil-burning boilers are operated, then fires are checked, also draft, the furnace for excessive carbon deposits, proper temperature and pressure of the oil. Check all gages, steam pressure, steam flow, water flow, oil meter, stack temperature meter, and damper control to make sure it is in its proper setting. Make sure all oil is cleaned up around the boiler, all oily rags are disposed of. Make sure that all burners (spare burners) are clean and have the proper tips in them. Keep the boiler room and all its operating equipment clean and in proper running order. Have spare water glasses and grommets, gaskets and other necessary replacements in a handy place, so the least amount of time will be lost when making any repairs.

Time Lost Is Money Lost.—Other duties to remember coming on watch are the feedwater treatment and the proper blowing down of the boiler as well as the proper time for the blowing of the tubes. Much more could be added to the engineer's duties, but what is mentioned will cover all when there is close co-operation between the watch engineer and the men under him. Different types of plants call for different working conditions, but I believe this is what is to be expected in the average large plant.

T. F. CUNNINGHAM

Philadelphia, Pa.

Comments from Goldsmith

The watch engineer is responsible for the operation of the entire plant during his shift. He answers to the chief engineer.

The fireman is responsible for the operation of the boiler room and the equipment in it. He answers first to the watch engineer and then to the chief.

The oiler is the watch engineer's helper. He takes care of the routine oiling, wiping, cleaning, and inspections of running equipment. By doing this work he frees the watch engineer so that he can be about the plant as a whole and act as general supervisor.

The oiler and fireman have no responsibilities to each other as such, but usually konw enough about each other's jobs so that they they can help each other in case of trouble.

R. B. GOLDSMITH, JR.

Beverly, Mass.

Answer No. 378

WHY DO DUPLEX PUMPS SLAM WHEN FEEDWATER TEMPERATURE DROPS ?

Heater Is Too Low Says Persinger

CONCERNING question on duplex feed pumps submitted by J. R. H. I believe the cause of his trouble is the lag encountered between pressure change in heater and corresponding temperature change at pump suction inlet. I have assumed that the open heater mentioned operates at a pressure corresponding to the feedwater temperature. I have also assumed that the compressors you mention are a criterion of the plant load.

At the high load condition of feedwater temperature 230 F, conditions exist as follows:

Absolute pressure in heater = 20.78 lb

Absolute pressure at pump suction flange = Heater pressure + Elevation head + Velocity head — friction loss

$$= 20.78 + \left(\frac{14 \text{ ft}}{2.31} \text{ by } 0.95 \text{ (specific gravity)}\right) + \left(\frac{1.55 \text{ ft}}{2.31} \text{ (Velocity assumed 10 ft per sec)}\right) - \frac{0.5 \text{ ft}}{2.31} = 26.69 \text{ psia}$$

net positive suction head (NPSH) =

Absolute pressure at suction flange	26.69
— Vapor pressure corresponding to 230 F	20.78
	5.91

NPSH = 13.65 ft

The NPSH is adequate at this rating, but consider the conditions ex-

isting as the load changes and the heater pressure drops to atmospheric with a temperature of 200 F.

Absolute pressure in heater ..... = 14.7 lb

Absolute pressure at pump suction ..... = 14.7 + $\left(\frac{14 \text{ ft}}{2.31} \text{ by } 0.95 \text{ (specific gravity)}\right)$ = 20.16 lb.

The value of velocity head and friction loss is neglected at the low rating.

Thus, NPSH = absolute pressure at pump 20.16 — Vapor pressure corresponding to temp. of 230 F which actually exists at the pump suction 20.78.

It is evident that this is not a correct value of NPSH at pump suction to prevent flashing. Flashing will occur until the 230 F water is removed from the pump suction line. The mistake is not yours but rather that of the designer. The open heater should have been placed at a higher elevation. To rectify your trouble you must increase the height of the heater or arrange to maintain constant pressure. NPSH value should never be less than 12 ft under all conditions of operation. The trouble you are experiencing would be more apparent if the pumps were centrifugal, such pumps should never be installed with less than 12 ft NPSH. With higher pressures and capacities and at higher operating speeds the NPSH must be increased progressively. A rough method of checking the practicability of a proposed NPSH is to consider the "temperature margin" or the difference in temperature corresponding to the suction flange pressure and the temperature of the feedwater at suction flange. The "temperature margin" should not be less than 20 F for pumps handling water around 212 F, while for temperatures in excess of 240-250 F a margin of 5 F will usually be sufficient. You can obtain more complete information by asking any one of various manufacturers for the curves they recommend. The Hydraulic Institute has published curves to meet different operating conditions, but they are probably less conservative than those proposed by the manufacturers.

Baltimore Md. M. PERSINGER

Answer No. 379

WHAT FLOOR PAINT WILL RESIST CREOSOTE?

I WOULD SUGGEST the use of a quick drying deck lacquer, using an alcohol thinner. Several manufacturers supply this paint in a number of colors.

A lawn green may sound odd, but in extensive marine use I found it a durable and serviceable color. It is less apt to fade and does not show the marks usually left by maintenance and operation work in an engine room. It will also blend with the gray already used on the pumps.

The use of black or dark shades of paint should be avoided since it encourages the men to take a "Can't notice it, leave it" attitude. Also, there may be a considerable reduction in the necessary candlepower of lighting where light, reflecting colored paints are used rather than colors which absorb the light.

Machinery which is subject to excessive heat such as steam cylinders and heads, should not be coated with ordinary paint. It soon discolors and makes maintenance work difficult, causing additional labor of clean-up or repairing. To protect these machines and make them look like machinery, they should be painted with a mixture of powdered graphite, cylinder oil, coal oil thinner, and colored with prussian blue. This will afford a protective coating and, at the same time, keep nuts and studs lubricated in a manner so they will come adrift with the use of a normal wrench.

This color scheme: green, gray and natural blued metal, is durable, practical, and should prove economical, as well as encouraging the man who take pride in appearance of the engine room.

Detroit, Mich. LATHAM V. THATCHER

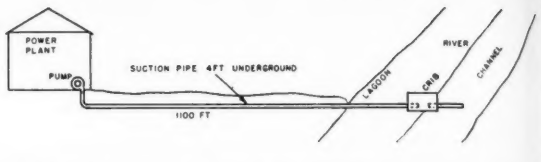


Fig. 1. General arrangement of crib in river for intake to pumps, as used by Slavinsky

Answer No. 383

WHAT PUMPS AND CONTROL FOR THIS CIRCULATING WATER?

Slavinsky Does It with Crib and 10-Speed Motor

THERE ARE several ways and means of pumping water from tidal creeks. Our plant is located on a tidal creek and we are pumping water to our turbine condensers without any trouble whatsoever. We have been pumping from this creek for the past 20 years.

Not being familiar with A. E. S.'s problem such as the depth of the river and whether he can use the pump near his condenser rather than use it at the river, I will go into detail and try to explain the way we are getting our water. We are using a 10 in. by 16 in. three (3) Lobe Roots-Connersville cycloidal pump which is operated at 89 rpm having a displacement of 7.7 gal per revolution. Chain connected to this pump is a 30 hp motor of 10 speeds. When the tide is high and there is plenty of water in the river we can slow down the pump. In the winter time when the water temperature is low, the pump is slowed down and in the summer when the water temperature rises we speed up the pump to put more water through the condenser. From the river to our condenser the distance is about 1100 ft. Before we installed this system we built a crib out in the river as we are located near the lagoon. The way this crib was built, the water being pumped to the condenser had to be pumped out of the crib. This crib keeps out driftwood and other floating items, such as ice in the winter time.

The idea of this layout was to not only keep out driftwood and other foreign matter, but also to get clearer water. When the tide is low the water in the lagoon goes out until the bottom boards of the crib are visible.

We are using an open pipe from the channel to the lagoon. The idea of this pipe is to allow under surface water to enter from channel to crib. The suction line of the pump is run from the crib to the condenser circulating pump 4 ft under ground. Just before the pump suction we have installed an Elliot twin strainer which can be changed when dirty, while pump is in operation.

JOHN F. SLAVINSKY
Rochelle Park, New Jersey

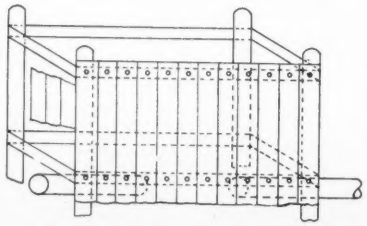


Fig. 2. Details of crib by Slavinsky

Answer No. 386

WHAT MAKES THE BOILER DRUM BUMP?

AS DESCRIBED by C. L. S. the bump occurs when the boiler is in, and out of service, and is one of a battery. Also the bump seems to occur at the steam drum.

From the above I would suggest that C. L. S. inspect all the hangers supporting his steam header, and connection between header and boiler, *very carefully*, to see that none of them are too tight, and freezing the line.

It is evident that the bump is caused by expansion or contraction some place; and a condition could exist where a hanger or support is tight enough to cause the line to build up a considerable stress before releasing it with a suddenness sufficient to cause the bump at steam drum to which it is connected.

The second assumption would be

the slipping of the drum, or maybe the drum's saddle, on the supporting structure. However, C. L. S. explains this condition was inspected and contact points oiled. But he didn't say whether or not shoulders had been worn. Where expansion or contraction may cause some parts of these supports to slip over a worn shoulder even though they were oiled.

Then it could be, even though the boiler be drained and open, there is enough temperature in it when showered with a stream of cold water while washing (as described by C. L. S. when one bump occurred) to cause the tubes to contract enough to raise the bottom or mud-drum which may be set too tight in the masonry causing it to release with a suddenness and make the bump appear to be at the steam drum.

Check carefully every possible point on boiler, and its connections to see that adequate provision has been made for all parts to expand and contract freely, and I believe the trouble will be found.

It is hoped that C. L. S. will advise the readers of P. P. E. the exact cause of the bump when located.

Columbus, Ohio — G. BROWNING

Answer No. 385

CAN THIS FAN BE IMPROVED?

Darnell Suggests Construction and Drive

As IS THE case with so many questions sent in, the above question lacks coherency and definition. J. C. E. gives side and end elevation views of a wheel for a proposed fan, and asks how the efficiency and construction of this fan can be improved.

There are a number of questions that must be answered before one can answer the above. First, the wheel is only part of the fan and we must know the scroll dimensions, that is, the radii generating the scroll before we can venture any opinion as to the performance of the wheel. Second, if this is only a proposed fan which J. C. E. plans to build himself, why are there so many conditions which cannot be altered?

Third, what volume and pressure does J. C. E. expect this fan to produce in order to operate his oil burner?

Presumably the fan wheel will be mounted on the motor shaft, (See Fig. 2) but if the fan is only "proposed" and not already built, the wheel could be overhung on two bearings with an overhung pulley, (See Fig. 1), and a belt drive provided so that the speed of the fan wheel could be reduced if the characteristics of the fan were such that a speed of 1600 rpm would produce such volume and pressure that the resultant power would overtax the motor which is rated at about 1/31 hp. On the other hand, if permissible, the fan speed could be increased. A wheel of about 4 in. diameter with properly designed blades, turning in a housing only 1⅞ in. wide, even if the scroll dimensions are ample, will deliver only about 15 or 20 cfm at, say ½ in. static pressure at 1600 rpm. Under such conditions, assuming a static efficiency of 60 per cent, the power required will be:

$$\frac{0.0001575 \times 20 \times 0.5}{60} = .026 \text{ or } 1/38 \text{ bhp}$$

As to the construction of the proposed wheel, J. C. E. says it must be stamped or formed out of a single piece of sheet metal, preferably duralumin. He may have some special reason for making such statement, but in the normal construction of a small wheel, of 4 to 4½ in. diameter, such procedure is not at all necessary and would be quite expensive.

A wheel with an effective diameter of 4 in. when running at 1600 rpm would have a peripheral or tip speed of:

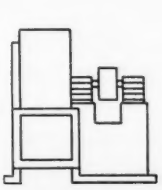
$$4.0 \times .262 \times 1600 = 1677 \text{ fpm}$$

At such relatively low speed, if there were no stresses set up in the blades due to the bending, the blade loading would not be excessive and the "hoop" stress would be within safe limits provided the thickness and quality of the plate were ample.

All of this, is, of course, not too definite but cannot be otherwise under the circumstances. However, if J. C. E. wishes to undertake the building of a wheel for such a small fan, I would suggest a circular back plate of about No. 18 gage sheet metal to which would be riveted 8 pieces of 1 in. x 1 in. angle of about 20 gage. These angles would be positioned radially on the back plate as per Figs. 3 and 4. The assembly of wheel, housing and bearings would be as shown in Fig. 1. Such arrangement would permit the use of a heavier shaft than might be possible with Fig. 2 where the wheel is overhung on the motor shaft and consequently there would be less defiection of the wheel and shaft.

Although wheels with backwardly sloping blades when properly designed have higher static efficiencies than those with radial blades, wheels with radial blades are easier to construct. A greater number of blades of lesser radial depth are required for backwardly sloping blades.

J. C. E. has the erroneous idea that there is some optimum angle at



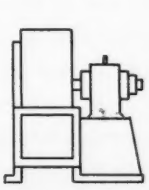


Fig. 1—Left, and Fig. 2—Right: Darnell's sweteches for two possible fan assemblies

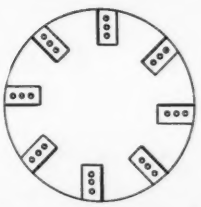


Fig. 3—Left, and Fig. 4—Right: Front elevation and side view of proposed design for fan suggested by Darnell

which the blades may be positioned in order to prevent distortion. As previously mentioned, the angle, that is, whether the blade is of the straight radial type, backward or forward curve, will determine the performance characteristics, but has no direct connection with blade loading. Blade stresses are kept within safe limits by various methods, such as warped surfaces, stiffening rings, added thickness of metal or alloy steels.

In the design and construction of centrifugal fans, there are so many important factors to be considered that those who have had no experience should not attempt the use of home-made devices but should consult reputable fan manufacturers who will recommend the proper type and size of fan for a particular duty.

For example, in casing design, the ratio of its width to that of the wheel is important. The cut-off point and its effect on the area of wheel exposure also is important. The ratio of casing inlet area to that of the wheel has a marked effect on performance and the shape of the inlet thimble or so-called "cone" may increase or decrease the efficiency of a fan by as much as 20 per cent. The outlet area and the design of the discharge piece or as it is sometimes called when vertical, the "chimney piece", has a marked effect on the conversion of velocity head into static head as formulated in Bernoulli's theorem.

Little has been published on the design of fans but for those who are interested in learning more about this interesting phase of engineering, see "Fans" by Baumeister. (McGraw-Hill Book Co. 1935)

Dallas, Texas — J. R. DARNELL

Answer No. 390

SHOULD HE REHEAT EXHAUST STEAM FOR PROCESS WORK?

M. M. G. should purchase a single or double extraction turbine designed to care for all his needs, when electric load is large enough to supply the low-pressure steam demand, and at such times that it is not, a desuperheater can be employed.

Also purchase the boiler and superheater to correspond.

Suggest a consulting engineer be called in.

Columbus, Ohio — G. BROWNING

Useful Information for Your File

DIAMETER, WEIGHT AND RESISTANCE OF STANDARD ANNEALED COPPER WIRE

ROUND SOLID CONDUCTOR

No. AWG	Diameter Mils	Area Circular Mils	Weight Bare Wire Pounds per 1000 Ft.	Resistance at 25° C (77° F) Ohms per 1000 Ft.	Resistance at 25° C (77° F) Feet per Ohm
0000	460	211,600	640.5	.04998	20,010.
000	410	167,800	507.9	.06302	15,870.
00	365	133,100	402.8	.07947	12,580.
0	325	105,500	319.5	.1002	9,980.
1	289	83,690	253.3	.1264	7,914.
2	258	66,370	200.9	.1593	6,276.
3	229	52,640	159.3	.2009	4,977.
4	204	41,740	126.4	.2533	3,947.
5	182	33,100	100.2	.3195	3,130.
6	162	26,250	79.46	.4028	2,482.
7	144	20,820	63.02	.5080	1,969.
8	128	16,510	49.98	.6405	1,561.
9	114	13,090	39.63	.8077	1,238.
10	102	10,380	31.43	1.018	981.8
11	91	8,234	24.92	1.284	778.7
12	81	6,530	19.77	1.619	617.5
13	72	5,178	15.68	2.042	489.7
14	64	4,107	12.43	2.575	388.3
15	57	3,257	9.858	3.247	308.0
16	51	2,583	7.818	4.094	244.2
17	45	2,048	6.200	5.163	193.7
18	40	1,624	4.917	6.510	153.6
19	36.0	1,288.	3.899	8.210	121.8
20	32.0	1,022.	3.092	10.35	96.60
21	28.5	810.1	2.452	13.05	76.61
22	25.3	642.4	1.945	16.46	60.75
23	22.6	509.5	1.542	20.76	48.18
24	20.1	404.0	1.223	26.17	38.21
25	17.9	320.4	.9699	33.00	30.30
26	15.9	254.1	.7692	41.62	24.02
27	14.2	201.5	.6100	52.48	19.06
28	12.6	159.8	.4837	66.17	15.11
29	11.3	126.7	.3836	83.44	11.98
30	10.0	100.5	.3042	105.2	9.504
31	8.9	79.70	.2413	132.7	7.537
32	8.0	63.21	.1913	167.3	5.977
33	7.1	50.13	.1517	211.0	4.740
34	6.3	39.75	.1203	266.0	3.759
35	5.6	31.52	.09542	335.5	2.981
36	5.0	25.00	.07568	423.0	2.364
37	4.5	19.83	.06001	533.4	1.875
38	4.0	15.72	.04759	672.6	1.487
39	3.5	12.47	.03774	848.1	1.179
40	3.1	9.89	.02993	1,069.	0.9350
41	2.8	7.84	.02374	1,349.	0.7415
42	2.5	6.22	.01883	1,701.	0.5880
43	2.2	4.93	.01493	2,144.	0.4663
44	2.0	3.91	.01184	2,704.	0.3698

BARE STRANDED ANNEALED COPPER CABLE — CONCENTRIC LAY

Size of Cable Circular Mils	Diam. Inches	No. of Wires	Diam. of Wires Inches	Weight per 1000 Ft. in Lbs.
250,000	0.576	37	0.0822	772
300,000	0.631	37	0.0900	926
400,000	0.729	37	0.1040	1,240
500,000	0.815	37	0.1162	1,540
750,000	0.999	61	0.1109	2,320
1,000,000	1.153	61	0.1280	3,090
1,250,000	1.289	91	0.1172	3,860
1,500,000	1.413	91	0.1284	4,630
1,750,000	1.527	127	0.1174	5,410
2,000,000	1.632	127	0.1255	6,180

Size of Cable Circular Mils	Weight per Mile in Lb.	D.C. Resistance at 25° C. (77° F.) Ohms per 1000 Ft.	D.C. Resistance at 25° C. (77° F.) Ohms per Mile	Feet per Ohm at 25°C
250,000	4,076	0.0432	0.2281	23,150
300,000	4,889	0.0360	0.1901	27,750
400,000	6,547	0.0270	0.1426	37,050
500,000	8,131	0.0216	0.1141	46,300
750,000	12,250	0.0144	0.0760	69,450
1,000,000	16,315	0.0108	0.0570	92,600
1,250,000	20,381	0.00863	0.0456	115,900
1,500,000	24,446	0.00719	0.0380	139,100
1,750,000	28,565	0.00616	0.0325	162,300
2,000,000	32,630	0.00539	0.0285	185,500

Here are two tables giving the diameter, weight and resistance of both standard annealed copper wire and also of bare annealed copper cable. It should be of use to every engineer having occasion to figure conductor size. Tear out this page and file it in a regulation manila folder, or punch it and keep it in a binder for future reference. The technical data contained in the tables is based on U. S. Bureau of Standards work and is reproduced here by courtesy of the WESCO Reporter, published by Westinghouse Electric Supply Company

GEIGER COUNTER

THE CONCEPT of radiation, keystone of modern physics, is bewildering indeed to the layman. Here lies that strange, unreal world where matter and energy merge, where unseen light may burn and kill deep under the skin, where voices are carried on nothingness at fantastic speeds. The physicist talks of X-rays, of radio waves, of cosmic rays, of radiation from uranium and atomic bombs. What does he mean?

Briefly, radiation is the release and transmission of energy by changes in the atom or the atomic nucleus. Some changes result in emission of pure energy, such as light. At other times, as in the case of radium, actual fast-moving particles are thrown off.

Nearly 40 years ago, Hans Geiger, a German student of England's Lord Rutherford, invented a mechanism to detect radiation. The Geiger counter, which can reveal the presence of a single, tiny electron, is science's most sensitive instrument. Moreover, it is fast becoming one of the most important tools of science, a vital aid to the nuclear physicist and of increasing medical and commercial value.

High energy radiation, whether from X-rays, radium, atomic bombs or cosmic rays, is able to ionize or charge electrically neutral gas molecules either directly by simply knocking off electrons or indirectly. The electrons carry a negative charge, and the molecules from which they are separated become positively charged ions. This resembles the photoelectric effect of visible light which is also radiation of relatively low energies. The ionization property is used in the Geiger counter to detect and estimate the intensity of radiation.

The counter consists of a vacuum tube in the form of a negatively charged metal cylinder through which a positively charged wire is stretched. The difference in potential between wire and cylinder may run from 250 to 5000 volts. Radiation, permitted to enter the tube through a window, ionizes the small amount of gas left in the tube.

The positive ions move toward the negative metal walls; the free electrons rush to the wire. The motion produces a pulse of electricity large enough to be measured. Upon reaching the wall the ions are again neutralized, the pulse dies away and the counter is sensitized for the next ray or particle. In a "slow" counter the electric pulse persists from one-tenth to one-hundredth of a second following the entrance of the radiation; in a "fast" counter it lasts only one ten-thousandth of a second.

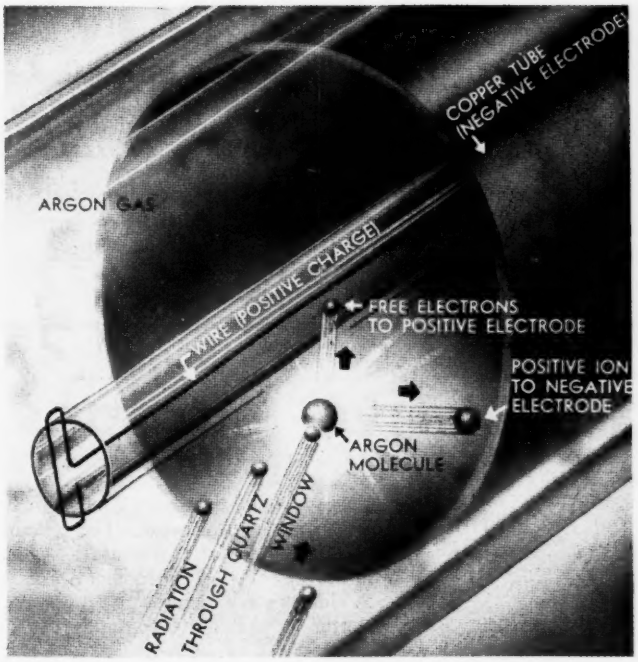


Fig. 2. Enlarged view of the end of the Geiger Counter showing its action

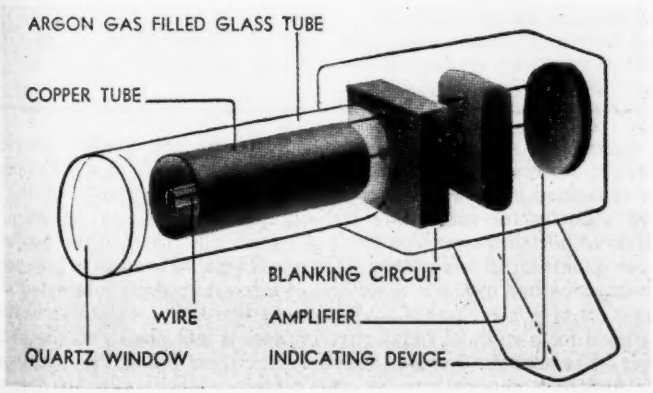


Fig. 1. Phantom view showing the principal elements of a Geiger Counter

The feeble electric discharge generated in the process may be amplified to operate a mechanical counter, to mark an oscillograph or to click in a pair of head phones. The significance of the number of pulses per second depends upon the design of the instrument, the probable amount of radiation absorbed by the walls and the constancy and location of the source of radiation with respect to the counter.

We live constantly bathed in radiation of all kinds, so that a counter operates continually at a fairly constant rate. In the vicinity of a source of radiation, such as an X-ray machine or a capsule of radium, the number of pulses recorded goes up markedly. The counter is a super-snooper. An atomic bomb explosion, even on the other side of the world, releases enough radiation to increase its activity. Increasing use of radioactive tracers in medicine, scientific research and industry, has given it many new jobs. Foundries use it to inspect castings and forgings, petroleum companies for logging of oil wells, hydro-electric plants for estimating the volume of flow through the turbines.

ATOMICS

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Radioactive Isotopes as Tracers

Isotopes—what they are . . . Historical facts regarding their discovery . . . Natural nuclear transmutations . . . List of known stable isotopes . . . Meaning of transmutation . . . Artificial transmutation . . . Use of accelerating devices . . . Artificial radioactivity . . . Why radioactive isotopes are so important . . . Tracer technique . . . Hevesy's experiments . . . Method of detection of radioactivity . . . Geiger-Muller counter . . . Radio-autography . . . Improved equipment for tracer micrography

By ANDREW W. KRAMER *Managing Editor, Power Plant Engineering*

IN THE ARTICLE on Atomic Power Development, in the preceding issue, the production of radioactive isotopes was mentioned. Such radioactive isotopes, it was indicated, will be by-products of future atomic power plants, whether we use them or not.

Since these radioactive isotopes are very important, it will be worth while to consider them and their use in some detail. What are they? Of what value are they and why do they constitute a problem? Much has been written about radioactive isotopes since atomic energy became "popular," even in these pages, but to tell the whole story let us start at the beginning.

When the periodic system of elements was devised by Mendeleeff toward the end of the last century, it was thought that each element, such as hydrogen, oxygen, copper, mercury, etc., consisted of only one definite kind of atom. All copper atoms, for example, were assumed to be alike—each was thought to be identical in mass or weight and each had the same chemical properties.

Later on, this was found to be incorrect. It was found that an element may consist of different kinds of atoms, having identical chemical properties but differing in atomic weight by one or more units. Thus, a sample of oxygen will be found to consist mostly of atoms having an atomic weight of 16 but there will be a few rare ones with atomic weight of 17, and others having an atomic weight of 18. Chemically these three different atoms of oxygen are exactly alike. The difference in atomic weight is due to the difference in the structure of the nucleus. The more abundant oxygen atoms—those with atomic weight 16, have nuclei consisting of 8 protons and 8 neutrons. All oxygen atoms have 8 protons in the nucleus but those with mass 17 have 9 neutrons and those of atomic weight 18, have 10 neutrons.

Since the chemical properties of an element are dictated by the number of protons in the nuclei of the atoms, these atoms of different weight are called "isotopes"; that is they have the same place in the periodic table of chemical elements. The nuclei of isotopes differ from one another only in the number of neutrons they contain.

In referring to the properties of an atom, two terms are in general use; one, "atomic number" and the other "atomic weight." The atomic number is simply the number of protons in the nucleus. The atomic weight, is the total number of neutrons and protons in the nucleus. Thus the atomic weight of ordinary oxygen is 16 while the atomic weights of its two heavier isotopes are 17 and 18. The atomic number is usually represented by the letter Z; the atomic weight by the letter A.

This is the first of several articles dealing with the general subject of radioactive isotope tracers. Though still in its early stages, radioactive tracer technique is bound to become of increasing importance as the productive capacity for radioactive isotopes increases. As is indicated, the operation of nuclear power plants will automatically result in the production of great quantities of radioactive isotopes. These substances, their properties, production and use, are, therefore, of interest to those interested in the development of nuclear power production. In this first article, the historical background for a study of radioactive isotopes is laid down and the characteristics of radioactive isotopes considered in some detail. In a susequent article detailed applications of the tracer method will be presented

ATOMICS

Among the 92 common chemical elements, some 278 stable isotopes have been discovered. These differ from one another only in the number of neutrons and protons in their nuclei. If two nuclei have the same number of protons, (regardless of the total number of particles) they are called isotopes, and they belong to the same chemical element. If they have the same total number of particles, then they have the same atomic weight and are called "isobars" and in general they will belong to different chemical elements because the number of protons will be different.

As explained in other articles in this series, in the nuclei the neutron plays the role of a binding element which holds the entire nucleus together in spite of the very strong repulsive forces which the protons (being positively charged) exert upon one another. Thus, in the heavier nuclei, there is a slightly larger proportion of neutrons in the nucleus in order to overcome the rapidly mounting repulsive forces between the larger number of protons.

The most complicated nucleus known in nature is that of the heavy, or more common, isotope of uranium, U-238. As has been shown many times in other articles in this series, this nucleus contains 92 protons, (hence uranium has an atomic number of 92) and 146 neutrons, making a total of 238 particles; hence the atomic weight is 238.

Unstable Isotopes

Like several other heavy elements, uranium is not a completely stable nuclear configuration. Just why, we do not know but it is probably because of its complexity. It can become more nearly stable by splitting off from itself a helium nucleus, or alpha particle, and expelling this nuclear fragment from the nucleus. This is the origin of the "alpha" ray of radium and other of the heavy elements. The alpha particle is expelled from the nucleus with great velocity and so the swiftly moving alpha ray has found great usefulness as an atomic bullet. When a uranium 238 nucleus expells an alpha particle in this fashion, it becomes a nucleus having an atomic number of 90 and an atomic weight of 234. This is thorium 234.

This thorium nucleus, again, is unstable. It emits a negative electron or beta particle which changes one of the neutrons in the nucleus into a proton. Hence its atomic number goes up 1 unit, that is $90 + 1 = 91$. Its atomic weight, however, remains unchanged at 234. This is protactinium (Pa 234). This again loses a beta particle, changing it to U-234, with atomic number 92.

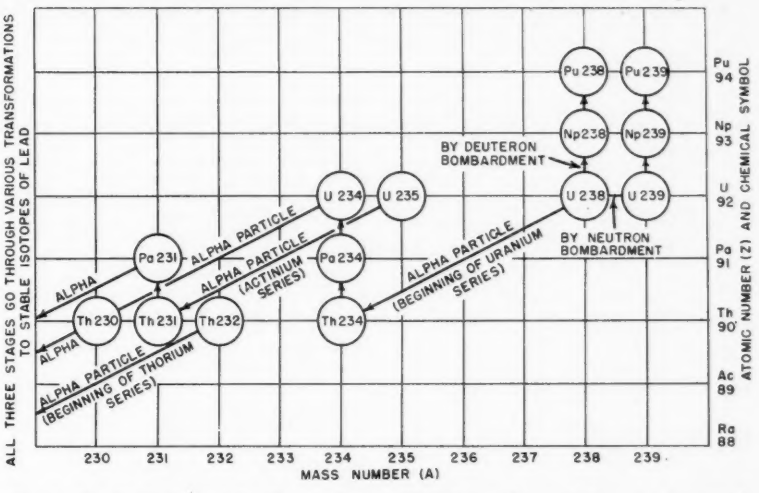


Fig. 1. The beginning, of the three natural radioactive series and the new transuranic elements neptunium and plutonium

In turn, this U-234 nucleus loses an alpha particle, reducing its atomic weight by 4 and its atomic number by 2. Thus, it becomes Thorium 230. The whole process is clearly indicated in Fig. 1, which shows the beginning of the three natural radioactive series as well as the new transuranic elements, neutunium and plutonium.[1]

These successive transformations by the emission of alpha particles and beta particles finally terminate in one of the stable isotopes of lead (PB 82). In all the elements below lead in the periodic table there are no spontaneous disintegrations. Spontaneous disintegrations occur only in the elements of atomic number higher than lead. These are called the radioactive elements.

In Fig. 2 is shown a diagram[2] in which each of the known "stable" isotopes appears as a square. The unstable isotopes are shown as circles. As already mentioned, these all appear at the high end of the periodic table.

These nuclei appear to represent all the stable configuration that can be made by taking an arbitrary number of protons corresponding to particular values of the atomic number, and adding neutrons in such numbers that stable nuclei result. A number of gaps appear in the vertical groups from which we can infer that these positions represent unstable configurations of neutrons and protons, and that if such nuclei were synthesized in the laboratory they might have interesting properties.

This, in fact, is the case, for all these nuclei (represented by gaps) are radioactive; that is, they spontaneously transform themselves into a more stable configuration. Transformations of this type are called "artificial radioactivity." There is no difference, however, between "artificial" and "natural" radioactivity. The term "artificial" is used only to remind us that the nuclei in question are not found in nature, but have been produced in the laboratory.

Transmutation

Such transformations as we have been describing are called "transmutation." The term "transmutation" originally implied an artificially induced change in the **chemical** properties of the atom. It was what the alchemists were striving for, in their fruitless attempts to transform baser metals into gold. Such a change, that is, a chemical change, as has been shown, means a change in the number of protons in the nucleus. Today, transmutation is used in a much broader sense to describe any change in the number of protons or neutrons in an atomic nucleus. Thus, atom smashing, or transmutation, is not always a smashing but is just as frequently a synthesis in which neutrons or protons are added to an original nucleus.

Suppose we consider a relatively simple case of transmutation in which a nucleus of heavy hydrogen is struck forcefully by another nucleus of heavy hydrogen. Since each nucleus of heavy hydrogen consists of only 1 proton and 1 neutron, it is evident that when two of these nuclei are forced together, the resulting nucleus will consist of 2 protons and 2 neutrons. This is the nucleus of ordinary helium, $_2He^4$. The two heavy hydrogen nuclei, however, are positively charged and repel each other with

[1] For a detailed description of the transformation of U-238 into neptunium and plutonium; see "Uranium and Atomic Energy," by A. W. Kramer, Power Plant Engineering, October, 1945.

[2] "Atom Smashing and Its Applications to Medicine," by Robley D. Evans. Electrical Engineering, June, 1941, page 250.

Fig. 2. Diagram showing all the atomic nuclei occuring in nature

Staple isotopes are shown as squares, naturally radioactive isotopes as circles. The horizontal co-ordinates represent the atomic number Z, that is, the number of protons in the nucleus. The vertical co-ordinate is a compressed scale of mass number, or atomic weight, A. The quantity actually plotted is (A-2Z) that is, the number of excess neutrons over and above a number of neutrons which is just sufficient to equal the number of protons in the nucleus. Therefore, vertical columns contain isotopes of the same chemical element, and adjacent squares represent isotopes differing from one another by one neutron. Over 500 artificially radioactive isotopes have been produced to fill in the gaps above, between and below the stable isotopes

great force at atomic distances. Therefore, to bring two such nuclei together, it is necessary to fling them at each other with enormous velocity —far greater than anything we can achieve by ordinary explosive forces. When two such nuclei coalesce, the composite nucleus may be in a highly excited state, that is, a great deal of excess energy may be present and so, one or more neutrons or protons may be expelled from the group of 2 neutrons and 2 protons; this leaves 2 protons and 1 neutron. This nucleus is still helium since its atomic number (the number of protons) is 2, but since it only contains a total of 3 particles, it is a nucleus of "light" helium. This artificially produced "light helium" is identical with a known, but very rare, stable isotope of natural helium.

Thus, in the collision between 2 nuclei of heavy hydrogen a composite nucleus is formed, a neutron is expelled, and there remains a nucleus of light helium. Two atoms of heavy hydrogen have been "transmuted" into an atom of light helium and there has been produced also, a free neutron. (See Fig. 3)

The external electrons, which move in orbits external to the nucleus of an atom play no part in the transmutation. They follow the nuclei around as best they can.

How It Is Done

Having described the process, a natural question is, how is this transmutation accomplished. As already indicated, to be successful, it is necessary to hurl one nucleus against another nucleus with great velocity. That is what made it so difficult at first. Until relatively recent years, we had no method by which to accelerate particles to the enormous velocities required. For this reason the "alpha" rays from natural radioactive substances were used in all the early work. The alpha particles are expelled from natural radioactive substances, radium, thorium, etc., with great velocity, some of them moving at better than 1/15 the velocity of light. This would carry them around the earth in less than 2 seconds.

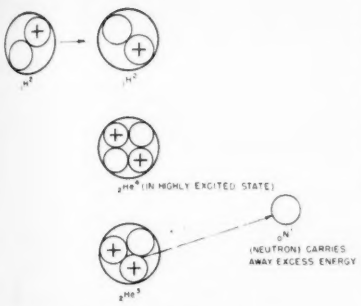


Fig. 3. Diagram showing the transmutation of two heavy hydrogen nuclei into a nucleus of light helium

The kinetic energy of the alpha particle is about 5,000,000 electron volts. Since the kinetic energy of each atom in a highspeed rifle bullet is less than 1/10 of an electron volt, it is seen that the energy of the alpha particle is some 50,000,000 times the energy of the atoms in the rifle bullet. Since such alpha particles are expelled, spontaneously, from substances such as radium, it is obvious why these natural rays were used by the early investigators. One had merely to expose a "target" to the action of the rays from radium, to produce a bombardment of the target.

Accelerating Devices

As more and more discoveries were made it became desirable to develop methods whereby other atomic nuclei, besides alpha particles, could be accelerated to high velocities. As a result, a number of different accelerating devices were developed. These are machines in which positively or negatively charged particles are subjected to the action of intense electric and magnetic fields, thereby accelerating them to high velocities with consequent high kinetic energy. As an example, ionized hydrogen atoms—that is, hydrogen nuclei—can be produced in an electric arc. If these hydrogen nuclei are then placed in an electric field of several million volts potential, they will attain high velocities.

The nature of these machines—these accelerating devices—will not be described here since they will be fully covered in a subsequent article, but they are of several kinds. Some of these devices are used to accelerate positive particles such as protons, deuterons (heavy hydrogen nuclei) and alpha particles while others are more suitable for accelerating electrons. Since, the positively charged particles are very much heavier than electrons, most bombardment experiments are made with these positive articles as projectiles.

By placing a "target" containing the chemical elements in which transmutations are to be produced in the path of the "rays" produced by these machines, all sorts of transmutations have been effected. Indeed, bombardments of this kind have produced several hundred successful transmutations, including transmutations of every known stable chemical element. In many of these transmutations the final nucleus produced is identical with one that already exists in nature. In many cases, however, in over 500 cases in fact, the final nucleus produced is not known in nature and it is therefore, artificially radioactive. Such nuclei tend to undergo one or more spontaneous changes until they become a "stable" isotope. Artificially radioactive isotopes of every known stable chemical element have been produced and studied.

So far we have considered only such transmutations as have been brought about artificially, by the use of electrical accelerating devices—cyclotrons, betatrons, synchrotrons, etc. All of these devices produce small quantities of radioactive isotopes—only enough for refined laboratory purposes. Despite this, the combined yield of all these devices is far greater than could be obtained by the combined use of the alpha rays from all the refined radium in the entire world.

Since 1942, however, that is, since the first self-sustaining nuclear reaction pile was placed in operation at the University of Chicago on December 2, 1942, the radioactive isotope production has been stepped up many millions of times. These self-sustaining reactors, in converting U-238 into plutonium, and in the fission of U-235, produce relatively enormous quantities of radioactive isotopes as a consequence of the intense neutron radiation. Such piles are capable of producing radioactive isotopes in such great quantities that they can be used commercially in chemical process. It is this very fact—the fact that radioactive isotopes production is a natural consequence of the operation of these piles or reactors—that has made the subject of radioactive isotopes so important. As already pointed out, the operation of nuclear power plants will automatically result in the by-product production of these isotopes.

Artificial Radioactivity

Artificial radioactivity dates back to 1934 when Irene Curie, the daughter of Madam Curie who discovered radium, and her husband F. Joliot reported that certain light elements, such as boron, magnesium, aluminum,

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which had been bombarded with alpha particles continued to emit positrons for some time after the bombardment was stopped. In other words, alpha particle bombardment produced radioactive forms of boron, magnesium and aluminum. Curie and Joliot actually measured half-lives of 14 minutes, 2.5 minutes and 3.25 minutes respectively, for the radioactive substances formed by the alpha particle bombardment.

This discovery was of tremendous importance, because, for the first time, man had been able to induce radioactivity in elements outside of those naturally radioactive. The experiments of Curie and Joliot stimulated similar experiments all over the world. Almost immediately E. Fermi, reasoned that neutrons, because of their lack of electric charge, should be highly effective in penetrating atomic nuclei, especially those of high atomic number which repel protons and alpha particles strongly. He was able to verify his predictions almost immediately, finding that the nucleus of the bombarded atom captured the neutron and that there was, thus, produced an unstable nucleus which then achieved stability by emitting an electron. Thus, the final stable nucleus was one unit higher in atomic number than the initial target nucleus.

Types of Radioactivity

The phenomenon of radioactivity, artificial or natural, is the consequence of changes in the nuclear structure of the unstable atom in the process of achieving stability. In many cases, as in the case of radium, which finally becomes lead, a large number of successive steps are necessary. At each step some sort of radiation occurs; sometimes an alpha particle is emitted, at other times an electron (positive or negative) is emitted Sometimes a gamma ray is radiated.

Actually, there are five distinct kinds of radioactivity. We have already mentioned alpha particle radioactivity which is common to the natural heavy radioactive substances such as uranium, thorium, radium, etc. Such substances also emit beta particles, that is electrons. Among the artificially radioactive substances,

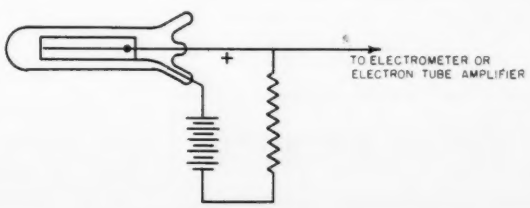

Fig. 4. The Geiger-Muller counter. (Also see article on the Geiger Counter on page 101 of this issue.)

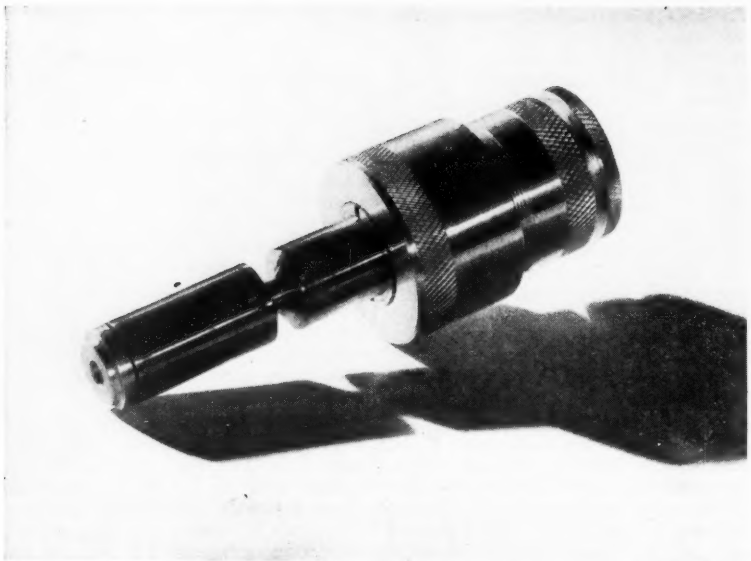

Fig. 5. Pole pieces of the magnetic lens developed at the National Bureau of Standards. A tantalum disk with a radioactive sample on its surface has been inserted at the left. The larger portion at the right is a simple film holder. When a strong magnetic coil (not shown) is placed around the pole pieces a magnetic field is produced, which focuses electrons emitted by the radioactive isotopes upon a photographic film. An image is thus formed showing radioactive areas

beta ray activity is most common. It consists of the emission of either positive or negative electrons.

In a fourth type of radioactivity an electron is captured by an atomic nucleus. There is a fifth type, called "isomeric transition" which involves only a shift in the configuration of the neutrons and protons in the nucleus without any change in the number of either.

In addition to these types of radioactivity mention must be made of gamma radiation. Gamma rays are produced in the spontaneous disintegration of radium and the other heavy natural radioactive elements. This type of radiation; which is not a particle but an electromagnetic radiation similar to the X-ray except that it is much more penetrating than the usual X-ray. Quite a large number of artificial radioactive transformations yield a final nucleus which is not quite in its most stable state, and which almost immediately settles down into its most stable or "ground" state by the emission of energy in the form of gamma ray. The energy of these gamma rays is just sufficient to take away the extra energy in the nucleus. The gamma ray, being an X-ray of extremely high frequency and penetrating power loses its energy in ionizing atoms which lie in its path.

[3] "Uranium and Atomic Energy." Power Plant Engineering, October, 1945.

As already indicated in the majority of cases, artificial radioactivity is characterized by negative-electron beta-ray emission. No specific example of the formation and disintegration of a radioactive isotope will be given here, since the case for radioactive phosphorus was fully described in an earlier article presented in this section.[3] The process is similar in all cases. A stable nucleus, as a result of bombardment, becomes unstable and as a consequence emits particles of one type or another in an effort to regain stability. The final stable nucleus may be different from the original nucleus, but it will be stable. The time interval between the formation of a radioactive nucleus and its subsequent decay depends upon the details of the nuclear configuration, and it varies from one radioactive substance to another over extremely wide limits. In the case of radioactive phosphorus, for example, 35 out of every million such nuclei undergo the spontaneous transformation to stable sulphur each minute. This is the same as saying that half of any given initial stock of such radioactive atoms will remain unaltered for 14 days. This is its "half life" the usual way in which the rate of decay of a radioactive substance is expressed. In some cases, the half life is only a few minutes or even a fraction of a second. In others it is measured in years and even billions of years. The half life of radioactive carbon 14 is over a thousand years.

Why Are Radioactive Isotopes Important?

Now, we may ask, why are these artificially produced radioactive isotopes so important? The reason lies in the extremely high energy of the emitted particles. The beta-ray which is shot out from the decaying radioactive nucleus has a velocity nearly equal to that of light. In the case of radioactive phosphorus these electrons have kinetic energies up to 1,700,000 electron volts. In their headlong course through the surrounding matter, these electrons collide with thousands of atoms, losing energy at each collision, by ionizing the atoms in its path. Because of its

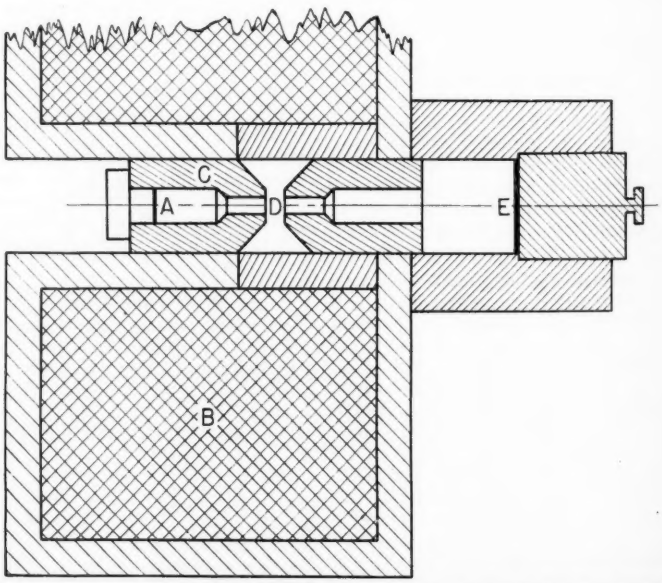

Fig. 6. Schematic diagram of the apparatus shown in Fig. 5. The radioactive sample is shown at A. The magnetic coil, B causes the soft iron pole pieces, C to produce an intense magnetic field at, D. Electrons emitted in nuclear disintegrations within the sample are brought to a focus upon the photographic film E

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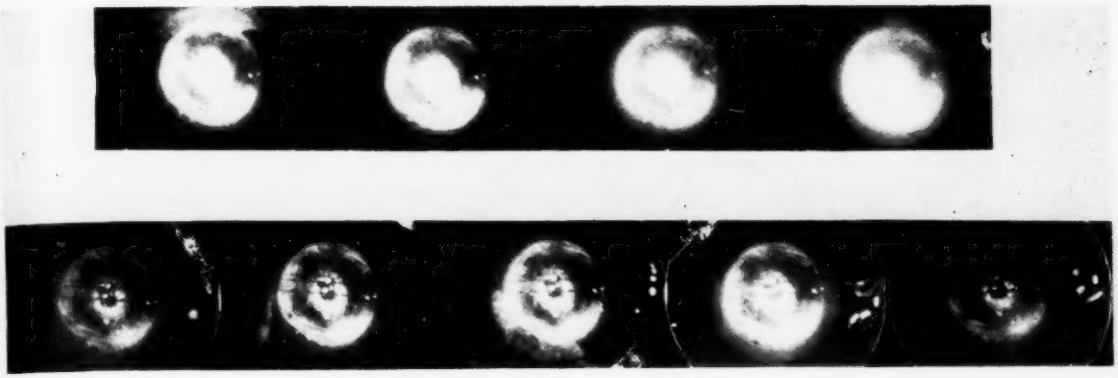

Fig. 7. Tracer micrographs showing the distribution of radioactive isotopes within a thin layer of sample material on the surface of a tantalum disk. Improved resolution in the lower row is due to reduction in the size of aperture

high speed this electron is easily detected by means of ionization chambers, electrometers or simple electroscopes. By means of such extremely sensitive instruments as the Geiger-Müller counter the individual beta-ray electrons can be detected—counted one by one.

Thus the course of a radioactive isotope may be followed in its passage through other matter, as in biological, chemical or physical transformations, by measuring the beta-ray activity at various points. Such radioactive isotopes of an element can take part in chemical and physical processes in exactly the same way as the familiar mixture of isotopes of that element which occurs in nature, while the isotopes in question (the radioactive isotopes) can always be recognized by the investigator and can be "traced" even in chemically identical environment, thanks to its radioactivity, or difference in atomic weight. Thus the name tracer. The isotope functions as a tracer, capable of furnishing evidence about processes taking place.

Hevesy's Experiment

The present widespread use of tracer isotopes in modern physics though a consequence of the discovery of nuclear fission, is due largely to the discovery of artificial radioactivity by the Curie-Joliots in 1934, and the subsequent discoveries and developments in nuclear physics. The method of tracer technique, however, has its origin in the work of Paneth and Hevesy as far back as 1913.

Hevesy used the method to test the theory of Arrhenius about the dissociation of electrolytes. In essence his experiment was as follows: From a certain amount of normal lead a salt is prepared, for instance, lead chloride. From a corresponding amount of the radioactive lead isotope which is formed as a disintegration product of radium another salt, for instance, lead nitrate is prepared. When the two salts are dissolved in water, the solutions mixed, then the two lead compounds are found to have become equally radioactive. The lead atoms from the two salts must, therefore, have been completely mixed in the solution. This result agrees with the hypothesis that the lead compounds are dissociated in the solution, i.e., that lead occurs in the solution in the form of free ions.

We have just said that one salt was prepared from normal lead and the other from the radioactive lead isotope. In order to carry out the experiment in this way, a sample of the pure radioactive lead isotope would have to be available. Actually, however, this is not necessary. It is sufficient if one sample of lead contains only a small amount of the radioactive isotope. Hevesy recognized this from the very beginning, as may be seen from the curious story of the way in which he came to use the isotopes in this way.

He had tried, vainly, to separate radium D from a quantity of lead containing a small amount of that substance. Since radium D is an isotope of lead (the radioactive isotope, listed in the radium series; its name dates from the time when there was no clear idea of the situation) it cannot, as we now know, be separated by ordinary chemical means. It was just that failure that gave Hevesy the idea that he could always distinguish the lead of the sample "contaminated" with radium D, from a sample of ordinary lead; in all mixtures with ordinary lead every fraction of the "contaminated" (radioactive) lead sample takes an equal fraction of the original radioactivity with it and can thus be determined quantitatively by measurement of the radioactivity.

The "contaminated" lead is thus, indicated or labelled by the radioactive isotope itself, and provided it is a homogeneous mixture the whole sample can serve as a quantity of labelled atoms. This fact is obvious when it is borne in mind that the radioactivity of an element only means that per unit of time a certain percentage of the atoms present in a sample disintegrates spontaneously. If the sample also contains a number of isotopic atoms which are stable and thus will never disintegrate, the only result, in the first instance, is that the percentage of disintegrating atoms per unit of time, is smaller—the radioactivity is diluted.

We have described these original experiments by Hevesy in detail, primarily for the historical interest they have. They were made at a time when knowledge of isotopes or of nuclear physics was extremely meagre. The fact that Hevesy recognized the principle is great credit to his insight into chemical and physical processes. He, by no means, confined his application of the method to exchange experiments. He realized the significance of radioactivity measurements as a substitute for chemical analyses. In subsequent years his and Paneth's students made extensive investigation of the mechanism of exchange reactions, of oxidation-reduction couples, the metabolism of plants and animals, and many other problems in chemistry and biology. Thus the groundwork and fundamental principles of the method of tracer isotopes all were worked out long before the Curie and Joliot team discovered the principle of artificial radioactivity in 1934. The early investigators were severely handicapped in their work because only the naturally radioactive isotopes were available, so "tracer" experiments could only be done on lead (with radium D), bismuth (with radium E), and thallium (with actinium C).

Hevesy's work, therefore, was ingenious and he made very practical use of his knowledge. The story goes that one time when he had reason to suspect the cleanliness of his landlady, he smeared a bit of "dirt" with a radioactive substance on it on his dinner plate. Thereafter he made

(Continued on page 144)

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Stack Dust Collection and Disposal

Experience of Detroit Edison Company with electrostatic precipitators and mechanical separators.* Storage of dry flue dust in bin. Disposal of cinders, furnace slag and fly ash. Low land filled for coal storage area. Fly ash used in cement, in asphalt, as soil conditioner, and as filler in low cost rubber goods

By P. W. THOMPSON, *Vice President in Charge of Engineering, Detroit Edison Company*

SENSING the potential nuisance to the neighborhood that would arise through the uncontrolled emission of fly ash from the stacks, the Detroit Edison Co. pioneered in the use of Cottrell electrostatic precipitators at Trenton Channel. While this device has proven quite reasonably satisfactory as installed there, its effectiveness depends, as would be expected, on holding down gas velocities and avoiding intermittent or unequal concentrations of dust loadings.

Such concentrations can be minimized in several respects such as: (a) eliminating the need for soot blowing insofar as possible or doing the operation piecemeal to spread it over a longer period of time; (b) designing, to avoid unequal concentrations of dust through different sections of the precipitator; (c) installing dampers for closing off individual sections of the precipitator during progressive rappings; and (d) providing baffles and downspouts for catching dust rapped off the plates and diverting it into the removal hoppers without opportunity for reintrainment in the flue gas. Cottrell precipitators of more liberal design were adopted for the company's second pulverized coal installation that has been in operation at the Marysville plant since 1942.

It is possible, however, that the economics of future installations may call for the use of mechanical separators of the vortex type for removing coarse particles ahead of the precipitator, thus leaving to the latter the collection of the fines alone. Latterly, experience with stoker firing at high outputs has demonstrated the need for collectors, particularly in thickly populated districts. Experience gained with mechanical collectors on such stoker jobs has indicated the possible inherent advantages of combining this device with a precipitator for pulverized-fuel boilers.

Another feature of the Marysville extension is the 1500-ton dry flue dust storage bin illustrated photographically in Fig. 1 and diagrammatically in Fig. 2. With this equipment it is possible to store an appreciable amount of pulverized coal ash. The ash-transport line leading from the power house is connected to a two-way valve at the top of the structure by means of which the ash can be diverted either into the storage bin or to the loading hopper. Ash to be hauled away from the plant in the dry state is loaded into suitable containers or closed conveyances by flexible hose connected to a pipe leading from the loading hopper. To draw the ash from the storage bin, the material is fed into a pneumatic transport pump located at the bottom of the bin. This pneumatic pump is mounted on a narrow-gage rail truck so that in the event additional storage bins are built in the future, the same pump can be used to serve them.

*Portion of paper entitled "The History and Use of Pulverized Fuel at Detroit Power Stations" presented at the conference on Pulverized Fuel held on June 3-6 at Harrogate, England, by the Institute of Fuel.

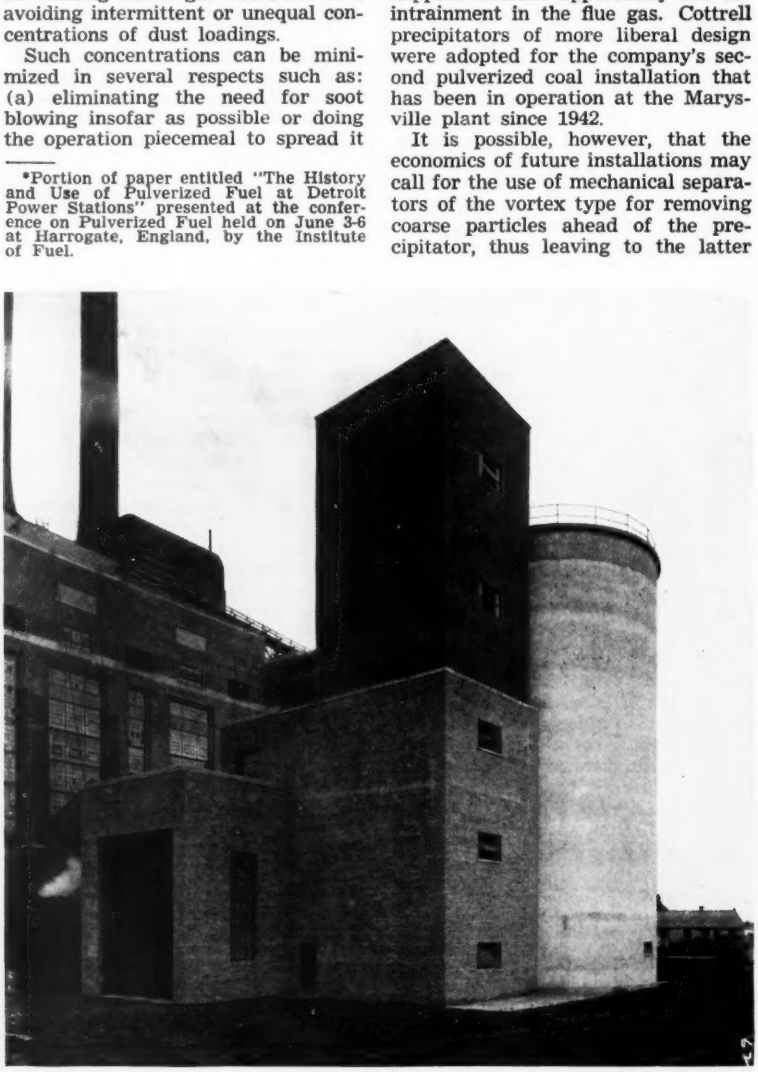

Fig. 1. Exterior view of flue-dust storage bin and associated ash-handling house

Disposal of Refuse

There has always been a good market in and about Detroit for cinders from stoker firing so that disposal of this sort of refuse has been no problem. Cinders are sold on a cash basis by the cubic yard at the power plants and are shipped either by rail or motor lorry. Cinders from the district heating plants are sold on yearly contract and removed daily by lorry. Pulverized coal furnace slag is hauled away by local people or sluiced into nearby marsh lands. No charge is made for the furnace slag. All Detroit Edison pulverized coal furnaces are of the dry-bottom type. Owing to the wholly different nature of pulverized-fuel fly ash which has precluded its use for the same purposes, entirely new markets had to be developed. Of the fly ash, or flue dust from precipitators, about 25 per cent is sold, the remainder is hauled to dumps.

FILL FOR LOW LAND: In the absence of such markets and during the course of their development it has been necessary to make other arrangements for disposal. The first and obvious alternative is to use any excess of pulverized coal ash for filling in low spots in and adjacent to the power plant, using convenient sluicing methods. Although the material does not make particularly desirable fill, this at least gets it out of the way until the plant site is completely filled. A second and more costly alternative is to pay for carting the refuse to some more remote dump site whose owners are willing to accept this waste material for fill, possibly for a consideration.

The coal storage on fly-ash fill at the Trenton Channel plant covers an area of five acres. The fill was made under water and consists of fly ash and furnace slag which were sluiced into a lagoon between the river bank and a water tight bulkhead. The grade was raised about six feet above river level giving a total depth of ash fill of about 20 ft at a maximum. The surface water for about the top six feet was allowed to drain off by making holes in the bulkhead when preparing the site for coal storage.

In the course of ten years following the fill period this whole area became covered with a dense growth of willow brush that was cut off a foot above grade and the whole surface covered with about a foot of cinders. The combination of a retaining wall with a high water level in the fly ash fill, plus the mass of intertwined willow roots probably is responsible for the ability of this fill to support the coal now stored on it. About one-half the area was used for storage the first year. Coal was piled and compacted with a bulldozer to a depth of approximately 35 ft as is usual company practice. Settlement of the fill under this coal loading was about one foot during the first year. The whole filled area is now used for coal storage. A word of caution may not be amiss in this description of a fly ash fill. Unless a fill were made under similar conditions as to water level, period of settlement, and had a similar growth of brush roots, there is no assurance that a fly ash fill could be used to carry load.

FINDING A MARKET FOR FLY ASH: Without waiting for the low areas about the Trenton Channel plant to be filled up, the Company over twenty years ago set about discovering and developing uses for which pulverized coal ash is suited. Some of the new uses such as for building blocks and replacement of a portion of the cement or sand in concrete are described in papers which have appeared in the technical press. After many years' development work, a turning point was reached in the year 1945 when revenue from the sale of fly ash finally exceeded the cost of handling and of hauling the unsold remainder to the dump. One reason for the previously unsatisfactory ratio of the amount of fly ash sold to that dumped was the lack of sufficient dry storage capacity at the Trenton Channel plant. Adequate storage is a necessary requisite because of short period demands by users which often exceed the daily production of fly ash. Hence, dry fly ash storage of 1,800 tons has been provided in connection with the Marysville plant extension, and similar arrangements are being made in extending Trenton Channel.

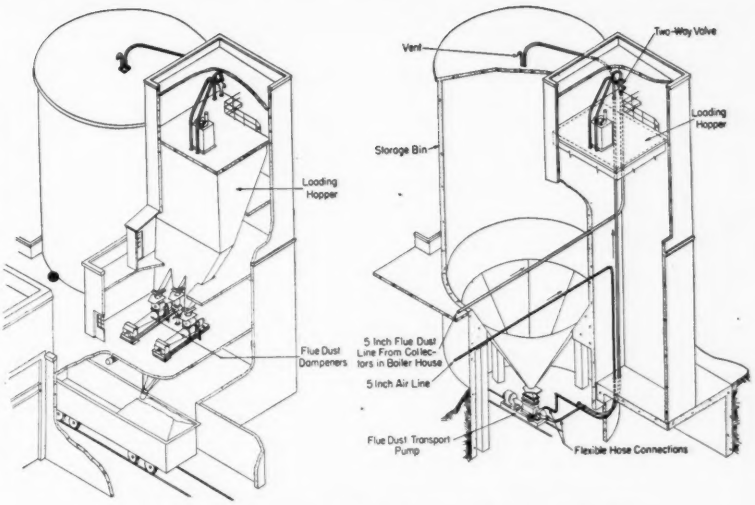

Fig. 2. Isometric view of flue-dust storage and handling facilities

Dampened ash is shipped in railroad gondola cars and dump lorries. Ash hauled to dump is dampened and loaded in dump lorries. Dry fly ash is loaded into covered hopper railroad cars and bulk cement lorries through overhead spouts that are adequately sealed and vented to minimize the loss of fly ash. There is a certain amount of dust with this method, but not enough to be considered a nuisance. Special bagging arrangements have been installed at Trenton Channel for filling 60 lb and 100 lb paper bags. At the present time fly ash is being bagged at the rate of about 2,000 tons per year for two firms manufacturing concrete admixtures.

The following is a condensed account of Detroit Edison practice and experience:

SUBSTITUTE FOR CEMENT AND/OR SAND IN CONCRETE: Pulverized coal fly ash has been used in concrete mixes as a replacement for both cement and sand. Considering a mix containing five bags of cement per cu yd of concrete, it is entirely feasible to substitute 100 lb of ash for one bag of cement, with or without a further substitution for sand. Substitution for the cement alone in this case would give a slightly lower strength at 28 days, but a higher strength at six months or a year. If additional ash is substituted for sand, as much as another 50 or 100 lb could be substituted for its equivalent absolute volume of sand, and this should be both more workable and stronger at all ages.

In the richer concrete mixes, the ash substitution for cement could be as much as 25 per cent. The limit of substitution for sand is hard to pin down, and the concrete engineer should work this out gradually until he becomes familiar with this new type of concrete. A favorable factor in adding fly ash to concrete mix is the better workability that results. This is especially true when the aggregate in the mix is blast furnace slag or crushed limestone.

As to the specific uses of concrete containing fly ash, there seems to be no reason why any general purpose concrete should not contain fly ash if it is used under the direction of a concrete engineer who would understand and use it only after making experimental batches, etc.

For instance, if used in floor slabs where the finish must be troweled, it would not be wise to use large quantities of ash. It does, of course, change the color of the concrete slightly, but unless brought into direct contrast this is not noticeable, particularly after concrete has thoroughly dried out. As much as 150 lb per yard has been used in concrete pavements with only 4½ 94-lb bags of cement. These pavements, after several years' service, have shown excellent durability and no spalling.

There has been considerable data already published indicating the strength and other characteristics of concrete containing fly ash, and also discussions as to such factors as carbon content and fineness.

AGGREGATE IN CINDER CONCRETE: Some 5,000 yd of concrete have been poured containing crushed cinders as coarse aggregate, and fly ash as fine aggregate, the latter amounting to as much as 500 lb or more per yard of concrete. In using this type of concrete for roof slabs the usual pre-

cautions must be taken for minimizing the tendency for blistering of asphalt or tar felts. Another large user is the cinder building block industry which has used as much as 2,100 tons per year.

CEMENT MANUFACTURE: During the year 1946, 2,600 tons of fly ash were used by a local cement manufacturer as a clay substitute. It is used for properly proportioning the alumina, iron oxide, and silica contents of the raw clay.

FILLER FOR ASPHALT PRODUCTS: The asphalt industry is the largest commercial market for fly ash so far developed in this territory. Between 6,000 and 7,000 tons of fly ash per year are sold as mineral filler for asphalt paving and other asphalt products. It is not known why, as yet, but not all pulverized fuel ash is a satisfactory mineral filler for asphalt or admixing material for concrete. The ash from the plants of the author's Company has been found satisfactory but ashes from at least one other plant have been found unsatisfactory. That plant burns coal from another coal field and their ash is finer and contains less carbon which may account for the difference in behavior.

SOIL AMENDMENT FOR HEAVY CLAY SOILS: A soil amendment agent can be defined as a material that has no fertilizing value in itself but which improves the soil with regard to workability, plant growth, and resistance to caking by changing its physical structure. A laboratory experiment with growing oats has definitely shown that a mixture of 25 per cent fly ash and 75 per cent clay is more workable, does not dry out as hard, and produces a larger growth of oats than a 100 per cent clay soil. A Company employee who used approximately fifty tons of ash in his vegetable garden reported improved soil conditions.

INERT FILLER FOR RUBBER GOODS: An attempt was made to interest the manufacturers of low cost rubber goods (automobile floor mats, running boards mats, pedal covers etc.) in substituting sized fly ash for the present inert filler material. The ash was classified as to size by passing it through an air classifier until 98+ per cent passed through a 325 mesh screen. A batch of rubber was made in a rubber manufacturer's laboratory using ash as a filler and the results obtained were surprisingly good, considering that it was the first attempt. This work, however, indicated that it would be difficult to produce light colored rubber products. Because of this limitation, no further work was done. If this color obstacle can be overcome, the rubber market would be a very desirable one because its requirements are non-seasonal and the possible revenue very attractive.

Another obstacle to the adoption of fly ash as a filler for rubber goods was the need for an extensive handling system. Dry fly ash is so light that it is necessary to have an absolutely closed system for handling it in a rubber plant. Other filler materials being much heavier do not require such an elaborate setup for handling. It is believed, however, that the expense of such a system could be paid for out of savings since fly ash can be sold so much cheaper than these other materials.

INGREDIENT FOR FOUNDRY CORES: During the war, fly ash was used extensively by aluminum and magnesium foundries as an ingredient in their cores. Experiments are now being carried on with gray iron and steel foundries to see whether it cannot be used to advantage in their cores.

COMBINATION WITH OTHER INDUSTRIAL WASTES: During the investigation of fly ash disposal, a survey was made of the other industrial wastes available in the Company territory. The waste (impure limestone) from soda-ash plants is available in large quantities and this product was combined with fly ash in an attempt to produce a satisfactory fill material. It was found possible to produce a substance whose physical properties compared favorably with a sand-cement stabilized mixture, but the difficulty of mixing this material precludes its use for fill purposes. It could undoubtedly be used as a stabilized soil, however, if economic conditions were favorable.

Aids for Small Business

Power industry's interest in small business ties in with C E D statement of policy . . . Tests for small business . . . Utilities cultivate patronage of small users . . . Distribution of informative literature . . . Aid from manufacturers

By RALPH E. TURNER, *Editor, POWER PLANT ENGINEERING*

WITH the release in June of a statement on National Policy by the Research and Policy Committee of the Committee for Economic Development entitled Meeting the Special Problems of Small Business, owners and managers of small business enterprises of the whole country were presented with a document prepared by the best informed business men and economists of the country and designed to assist the people of the country in formulating their own policies and carrying out practices which will result in reasonable profits to the owners, permitting them to continue in business and render a service to the community and nation.

This statement places before the business men of the country the fundamentals of American business that have been proven to be successful many, many times in nearly all types of small business and in all sections of the country.

Tests for Small Business

The Committee reports that 98 per cent of the number of firms in business are small, having less than 50 employes. It is stated that usually a small business will have two or more of the following characteristics: 1. Management is independent. Usually the managers are also owners. 2. Capital is supplied and ownerships held by an individual or small group. 3. Area of operations is mainly local. Workers and owners are in one home community. Markets need not be local. 4. The business is small when compared to the biggest units in its field.

Although under these tests for smallness, many power plants in the country, both utilities and those serving industries, would be classified in the small business column, all the utilities, big and small, have a definite interest in the prosperity of the small business units they serve for these units make up a generous portion of the load on the utilities.

Another branch of the power industry, a large portion of which falls in the small business classification, is the manufacturing of power equipment, auxiliaries, instruments and tools. Nearly all of these units are either small or have grown large from small beginnings. This group also has a decided interest in the prosperity of small business which buys a very large portion of the products of the power equipment manufacturers.

Utilizers of power in the commercial and industrial field are in both the small and large business classes but in numbers the small business units make up the vast majority.

There is a tie-in among these branches of the power industry that is conducive to wide-scale development and co-operative activities which is mutually beneficial. On the basis of pure selfishness, if you want to put it that way, each branch of the industry wants to see the others succeed, for each draws patronage directly or indirectly from the others.

The release of this C E D statement

suggests consideration of the activities of the power industry directed toward the betterment of business units which they serve as customers; all of which might be termed public relations activities.

Utilities Need Small Business Customers

Very good reasons are apparent why electric utility companies are vitally interested in the welfare of small business projects. Reports of the Edison Electric Institute for March 1947 show that 13 per cent of the number of customers served by the utilities are in the small light and power group. Small, according to classification employed by the Institute, means those units whose demand capacity is less than 25 kw.

The kilowatt-hour sales to these customers amounts to 17.2 per cent of the entire utility output, and the revenue from this group of customers amounts to 26.6 per cent of the total revenue of the utilities, compared with 28.2 per cent from the large light and power group.

Utility companies consider this portion of their load ideal, for it is extremely diversified, rarely affected to any great extent by labor troubles, the schedule of power use varies but little, customers in this group must pay service bills promptly, and small business units thrive best in and near residential districts served by the utilities which is a definite advantage in designing a distribution system.

Use of Pamphlets and Magazines

Probably the most common practice engaged in by utilities to aid small business units is the preparation, publishing and distribution of informative pamphlets and magazines. These deal with nearly all kinds of uses of electric power in commerce and industry. The preparation of food seems to be one of the most popular subjects discussed in these pamphlets which are distributed among restaurants, hotels, hospitals, bakeries, meat markets, sandwich shops and other food-preparation and dispensing establishments. The care and use of electric appliances used in the food industries is of first importance but in addition information is given on the management of various types of establishments based on experience of successful men in the field.

Human comfort and cooling systems depend to a large degree upon the electric service available, so pamphlets are distributed giving information on air conditioning, refrigeration, fans, ventilation, automatic furnace operation, temperature regulators, humidifiers and all phases of electric lighting.

Pamphlets are distributed periodically to bring up-to-date information on retail stores to managers of establishments serving various branches of this trade. In this field lighting is an extremely important feature. Textiles and furniture should not be modified in color by artificial lighting. Display windows need carefully designed lighting effects to accomplish their purpose. Switch arrangements and locations for the convenience of employes in serving customers need to be considered by retailers. These and many other items in which electricity serves the retailer are discussed.

Quite common among publications distributed by utilities are those dealing with the use of electricity in industry. In these are printed articles describing in detail, modern industrial processes where electricity from the utility's generating plant is applied in some way for mass or volume production. Canning chickens, assembling pianos, laundry operation, degreasing operations, infra-red paint drying, are a few of the subjects treated in a publication of this type aimed to assist managers of industrial plants.

Radios, motion pictures and television, all users of electricity, come in for treatment in some of these house organs. Some of these put in plugs for the industrial units they serve which is a very effective method of building good will among customers in any community.

Large public utility companies have found that the conducting of exhibits for the display and demonstration of electric power using equipment not only helps to build loads for the power lines but assists the manufacturers and distributors of the equipment to establish and improve their markets. Among the products thus displayed are: household stokers, radios, electrically driven tools, electric welding equipment, electric kitchen equipment, laundry appliances, in fact nearly every kind of electrical device used by the public and small industries.

Utilities have gone so far in their aid to small business and industry as to maintain a real estate department whose duties are to assist firms in finding buildings and locations for new businesses, ranging in importance from restaurants and retail stores to manufacturing plants just beginning operations and those requiring large sites for expanding production facilities.

Engineering Service Available

Another service provided by many large utilities is the advice and council of engineers specialized in the application of electricity to the problems of industry. These men work with the power salesmen to devise the most satisfactory arrangements for applying power to the many in industry where electricity is used to advantage.

The spirit of this activity is well expressed by Charles Y. Freeman, Chairman of the Board of the Commonwealth Edison Co. in his address at a recent meeting of the stockholders. He said, "Our Territorial Information Department, about which I have reported to you from time to time, continues to be a factor, we believe, in the long-term development of this region. Our purpose is to promote and publicise Chicago and Northern Illinois, and the Department gives voice to our belief that this territory is second to none as an advantageous location for working and living. Generous community recognition has been given to our companies for this forward looking activity."

Manufacturers Offer Aid

The manufacturing branch of the power industry also does its share in servicing its customers. The purchaser of power equipment expects and usually gets not only the equipment bargained for but a service which guarantees satisfactory operation in the application he has made of that equipment.

Managers of small business establishments who appeal to manufacturers and utilities for assistance in the application of power to some process will, almost without exception, be given worthwhile advice by competent application engineers regarding the selection and installation of equipment that will best serve their purposes.

If we may judge from the activities of the power industry (the term being used in its broad sense to mean the generators of power, the manufacturers of power equipment, and the utilizers of power) as outlined above, it is evident that there exists in this industry a determined effort to be helpful to small business as a policy adopted to maintain good public relations—and good business.

The aims of the C E D Committee stated in the closing paragraph of the report are as follows: "Our goal is equality of opportunity for every type and size of business. This is vital in preserving a healthy, growing and productive system of business enterprise, and by the same token, the well being of this country. The American business system is being questioned today in many places in the world. There is a responsibility that each business man act so as to strengthen the free enterprise system. It is a responsibility he owes to the system he believes in."

Large as well as small units of the power industry will find many helps in the management of their establishments in this pamphlet entitled "Meeting the Special Problems of Small Business" single copies of which can be obtained free upon request to the Committee for Economic Development, 285 Madison Ave., New York 17, N. Y. It represents many months of intensive study, by members of the Research and Policy Committee, of the problems of small business in the three major areas of management, financing and taxation, and competitive opportunity.

What Coal Fluidization May Do for the Power Plant of Tomorrow

Trends in fluid devolatilization of coal may make tomorrow's power plant a focal point for production of many by-products in addition to electricity . . . It may yield fuel gas, gasoline, lubricating oils, chemicals . . . Fluidization of coal yields char of 12,180 Btu per lb from 11,460 Btu coal . . . Also yields 8300—14,800 cu ft of fuel gas per ton coal, 15 gal of tar per ton coal . . . Process reduces sulfur in coal . . . Char forms a fuel suitable for burning in cyclone burner without pulverization . . . Char also pulverizes easier than coal . . . Lower hydrogen loss and less stack discharge when burning char . . . Process leads to manufacture of synthesis gas, and other by-products

By A. D. SINGH *President, Singh Company, Chicago, Illinois*

THE MOST WIDELY-USED fuel in the production of electrical energy is coal. Equally common is the practice of burning it directly in the boiler furnaces to raise steam, the motive fluid for the prime movers. In due tribute to the accomplishments of the power plant engineer, it may be stated that a condition near the saturation point has been reached for making further improvements along the conventional lines. Consequently, attention must be turned to some recent developments that seem to render the power plant field, insofar as coal is concerned, highly fertile for future explorations.

Much has been written during the last year or so on the possibilities of atomic energy entering the power plant field. Technological advances in the foreseeable future might indeed make possible the application of atomic energy, particularly in very large power plants. Although not by way of retaliation, it may be this same large power plant in which King Coal will most likely extend his utility in ways hitherto considered out of the scope of such plants. For instance, the power plant of tomorrow, most likely, will be the focal point for such operations as the production fuel gas, gasoline, lubricating oils, fertilizers, chemicals and many other articles of commerce. And to such a power plant coal will flow in quantities far in excess of those consumed in present-day practice.

A trend in the development of power plants along such lines has already made its appearance. Singh and Kane[1] in discussing the results in a paper entitled "Fluid Devolatilization of Coal for Power Plant Practice" before the 1947 Semi-Annual Meeting of the ASME, have concluded that Kincaid coal from Seam No. 6, Christian County, central Illinois, can be processed by the application of the fluidization technique, explained later in this paper, to produce:

(1) Char with a volatile matter content of 10 per cent by processing coal, crushed to pass a 20 mesh screen, at 1292 F (700 C). The heating value of the char is 12,180 Btu per lb compared with 11,460 Btu per lb of raw coal on a dry basis.

(2) Fuel gas at a rate of 8300

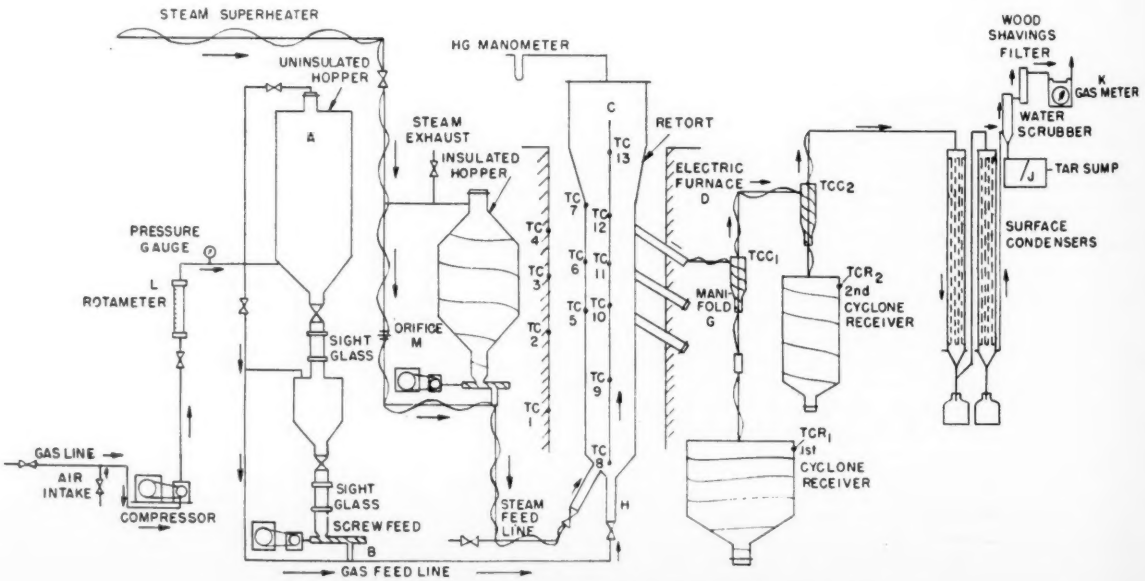

Diagram showing how fluid devolatilization process is applied to coal

cu ft at 1292 F (700 C) and 14,800 cu ft at 1472 F (800 C) per ton of dry coal. In terms of heat units the gas amounts to 40 therms at 1292 F (700 C) and 84 therms at 1472 F (800 C).

(3) Tar at a rate of 15 gal per ton of dry coal at 1292 F (700 C) and 11 gal at 1472 F (800 C).

(4) Char with an ash content 2 to 3 per cent higher than in raw coal when the process is operated at 1292-1472 F (700-800 C). At temperatures below 1022 F (550 C) the increase in the ash content of the char is insignificant. Reduction in ash content of char made in a temperature range of 752-1472 F (400-800 C) is believed to be due to mechanical separation of the high-ash-bearing fractions of coal and ash particles in the fluidizer.

(5) Substantial desulphurization of coal with steam during the devolatilization process, ranging from 38.5 per cent at 1472 F (800 C) to as high as 76 per cent at 1112 F (600 C).

(6) Saving of 4 to 6 per cent in the overall heat balance, due to lower hydrogen stack losses, and the recovery of sensible heat in the char that may be fed directly into cyclone type furnaces without further pulverization.

Process for Fluid Devolatilization of Coal

Fluid devolatilization is a term coined to express the application of the fluidization technique to the process of distilling fuel gas from finely crushed coal, accompanied by the production of a freely-flowing product called char. Fluidization may be simply explained by referring to the fluid-like behavior a finely divided solid substance acquires, when a current of gas or vapor is passed through a bed of the solid at a certain rate. The pseudo-liquid system so established obeys to a remarkable degree the laws governing flow of fluids, and the material under fluidization can be handled through chambers, pipes, valves and orifices as if it were a fluid.

The petroleum refining industry has applied fluidization in the handling of very large quantities of powdered catalyst in the production of gasoline. During the last war, Germany applied the same technique to the gasification of powdered brown coal to synthesize gasoline and lubricating oils to maintain her war machine. Neither the powdered catalyst used in the petroleum industry nor the brown coal, however, possessed the plastic property of a coking bi-

Table I—Screen analysis of char and coal materials used in fluidization tests

Fluid Bed Temp. °F	°C	Material	Wt. Per Cent Retained on U.S.S. Sieves 8	16	30	50	100	200	—200
1022	550	Coal	0.0	0.0	12.8	31.3	23.3	13.6	18.7
		Char in Feed	0.0	0.0	10.9	31.2	23.3	15.2	19.4
		Char Product	0.0	1.1	14.9	26.7	21.7	14.9	20.6
1051	566	Coal	0.0	0.0	12.8	31.3	23.3	13.6	18.7
		Char in Feed	0.0	0.0	13.5	31.1	24.4	14.7	16.5
		Char Product	0.0	0.8	13.4	26.0	22.3	15.3	22.0
1112	600	Coal	0.0	0.0	12.8	31.3	23.3	13.6	18.7
		Char in Feed	0.0	0.0	8.8	27.0	22.8	17.4	23.9
		Char Product	0.0	1.6	14.8	25.7	21.3	15.6	21.5
1292	700	Coal	0.0	0.0	12.8	31.3	23.3	13.6	18.7
		Char in Feed	...	...	...	...	...	...	...
		Char Product	0.2	0.7	8.9	24.2	23.3	18.3	24.4
1472	800	Coal	0.0	0.0	12.8	31.3	23.3	13.6	18.7
		Char in Feed	0.0	0.0	10.3	31.3	29.8	14.8	13.8
		Char Product	0.0	0.6	16.6	28.6	24.1	13.9	15.5

Table II—Summary of operating results in fluid char maker using raw or unoxidized coal

Temperature, °F	752	842	932	932
°C	400	450	500	500
1. Coal analysis as charged:				
Moisture, per cent	6.86	7.64	7.64	8.54
Volatile matter, per cent	33.68	34.32	34.32	33.06
Fixed carbon, per cent	45.00	45.24	45.24	44.20
Ash, per cent	14.46	12.80	12.80	14.20
Total, per cent	100.00	100.00	100.00	100.00
Sulphur, per cent	3.33	3.66	3.66	3.27
Volatile matter (ash and moisture free), per cent	42.8	43.2	43.2	42.8
Heating value, dry basis, Btu per lb	11,330	11,560	11,560	11,550
2A. Yield, per ton of coal as shipped*:				
Char, per cent	77.7	69.0	56.8	.....
Gas, cu ft	332	865	2050	2150
Gas, therms	2.05	6.30	11.80	.....
Tar, lb, dry basis	168	230	354	310
2B. Yield, per ton of dry coal:				
Char, per cent	91.5	81.2	66.8	.....
Gas, cu ft	390	1080	2410	2530
Gas, therms	2.41	7.40	13.9	.....
Tar, lb, dry basis	197	271	417	366
3. Char Composition:				
Moisture, per cent	0.0	0.50	1.59	.....
Volatile matter, per cent	30.6	26.4	10.29	.....
Fixed carbon, per cent	52.5	57.0	73.07	.....
Ash, per cent	16.9	16.1	15.05	.....
Total, per cent	100.00	100.00	100.00	.....
Sulphur, per cent	.....	2.89	2.88	.....
Heating value, per lb dry basis, Btu	11,310	11,500	11,740	11,780
4. Gas Made:				
Analysis (raw gas):				
CO_2, per cent	19.5	28.0	15.9	16.2
Unsaturates, per cent	6.5	7.6	4.1	5.0
O_2, per cent	2.3	0.0	2.5	1.2
H_2, per cent	3.0	5.5	20.3	12.7
CO, per cent	13.7	13.7	11.9	12.5
Saturates, per cent	27.1	35.9	32.1	37.8
N_2, per cent	24.5	4.9	4.5	7.2
H_2S, per cent	3.4	4.4	8.7	7.4
Sp gr of raw gas	0.986	0.963	0.849	0.836
Heating value of H_2S free gas, Btu per cu ft	639	718	630	.....
Analysis of H_2S and CO_2 free gas:				
Unsaturated, per cent	8.4	11.1	5.4	6.5
O_2, per cent	3.0	0.0	3.3	1.6
H_2, per cent	3.9	8.1	26.9	16.6
CO, per cent	17.8	20.2	15.8	16.4
Saturates, per cent	35.2	53.3	42.7	49.5
N_2, per cent	31.7	7.3	5.9	9.4
Sp gr of H_2S and CO_2 free gas	0.953	0.851	0.664	0.72
Heating value of H_2S and CO_2 free gas, Btu/cu ft	802	1014		878
5. Tar Made:				
Moisture, per cent	13.1	26.8	26.0	9.39
Free carbon, per cent	9.24	10.51	14.89	21.87

*Based on moisture content of 15 per cent in coal as shipped.

tuminous coal at very high temperatures. The direct application of the fluid devolatilization process to coking bituminous coal, therefore, is not practical, and the following is a brief description of the present process as applied to such coals.

Fluid devolatilization of a coking coal may be carried out in a system such as shown in the diagram. Coal, crushed to pass a 10 to 20 mesh U. S. S. screen, is screw fed from the hopper system into lines through which steam, or recycled gas produced in the process, flows at a sufficiently high rate to prevent settling of the largest coal particles present in the feed. The steam or gas, referred to as the fluidizing agent, carries the coal into a vertically mounted metal tube in which the temperature of the fluid bed of char is maintained at a desired degree. The tar vapor and gas are quickly evolved because of a rapid rise in temperature of the coal fed, and all the products, including the char, are led directly into a cyclone separator. The char, which is only slightly agglomerated as shown in Table 1, is drawn from the receiver, and the tar vapor as well as gas are passed into a cooling and condensing system for by-product recovery. Agglomeration of the char is controlled by previously oxidizing the coal and also by the recirculation of about an equal weight of char as that of the coal fed to the retort.

Possibilities of Fluid Devolatilization of Coal in Power Plants

Partial results on the fluid devolatilization of Kincaid coal as presented in Tables 1-3 inclusive offer some interesting possibilities in the application of this process in power plants. For a combined gas and electric utility enterprise, such a process should be especially attractive from a standpoint of handling the two main products, i.e., char and gas. Un-

Table III—Summary of operating results in fluid char maker using oxidized coal

Temperature, °F	932	1022	1050		1112	1202	1292	1472
°C	500	550	566		600	650	700	800
1. Coal analysis as charged:								
Moisture, per cent	1.35	1.09	1.00	1.09	1.09	1.03	1.09	1.65
Volatile matter, per cent	29.93	31.04	34.50	31.04	31.04	30.67	31.04	34.25
Fixed carbon, per cent	54.33	55.42	51.30	55.42	55.42	55.92	55.42	51.00
Ash, per cent	14.39	12.45	13.20	12.45	12.45	12.38	12.45	13.10
Total, per cent	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Sulphur, per cent	4.11	4.00	3.67	4.00	4.00	3.99	4.00	3.65
Volatile matter (ash and moisture free), per cent	35.1	35.9	40.2	35.9	35.9	35.4	35.9	39.7
Heating value, dry basis, Btu per lb	11,200	11,460	11,600	11,460	11,460	11,400	11,460	11,600
2A. Yield, per ton of coal as shipped*:								
Char, per cent	61.0	60.7	....		56.0	55.0	56.4	52.5
Gas, cu ft	2045	2230	2570		3480	5150	7050	12700
Gas, therms	9.2	11.2	15.0		16.4	23.7	33.7	71.7
Tar, lb, dry basis	236	163	179		169	159	115	83
2B. Yield, per ton of dry coal:								
Char, per cent	71.8	71.5	....		66.0	64.8	66.4	61.5
Gas, cu ft	2405	2625	3020		4080	6060	8300	14800
Gas, therms	10.8	13.2	17.6		19.3	27.9	39.4	84.3
Tar, lb, dry basis	278	192	211		199	187	135	97
3. Char Composition:								
Moisture, per cent	0.80	0.60	....		0.59	0.27	0 38	0.61
Volatile matter, per cent	16.50	16.60	....		9.02	10.70	9.95	1.77
Fixed carbon, per cent	65.60	67.70	....		73.91	71.51	73.68	80.27
Ash, per cent	17.10	15.10	....		16.48	17.52	15.99	17.35
Total, per cent	100.00	100.00			100.00	100.00	100.00	100.00
Sulphur, per cent	3.47	....	2.80		2.49	3.05	2.93	2.98
Heating value, dry basis, Btu per lb	11,770	11,400	....		12,140	12,250	12,180	12,100
4. Gas Made:								
Analysis (raw gas):								
CO_2, per cent	29.70	19.49	25.60		19.35	15.32	14.3	10.8
Unsaturates, per cent	4.00	2.70	4.70		3.00	3.60	4.3	4.5
O_2, per cent	0.00	1.90	0.90		1.00	1.30	1.3	1.4
H_2, per cent	10.30	24.10	14.33		24.70	32.20	34.4	41.0
CO, per cent	18.90	16.40	18.20		16.30	15.80	17.9	18.2
Saturates, per cent	28.40	25.90	26.80		19.30	18.30	19.6	14.2
N_2, per cent	1.00	5.10	1.40		10.20	8.50	3.9	7.9
H_2S, per cent	7.70	4.41	8.10		6.15	4.98	4.3	2.0
Sp gr of raw gas	0.909	1.06	1.09		0.953	0.773	0.764	0.739
Heating value of H_2S free raw gas, Btu per cu ft	484	527	632		503	483	495	578
Analysis of H_2S-CO_2 free gas:								
Unsaturates, per cent	6.4	3.5	7.1		4.0	4.5	5.3	5.15
O_2, per cent	0.0	2.5	1.3		1.3	1.6	1.6	1.60
H_2, per cent	16.5	31.8	21.8		33.2	40.5	42.2	47.00
CO, per cent	30.2	21.8	27.8		21.9	19.7	22.0	20.90
Saturates, per cent	45.3	34.0	40.8		25.9	23.0	24.1	16.30
N_2, per cent	1.6	6.4	2.1		13.7	10.7	4.8	9.05
Sp gr of H_2S-CO_2 free gas	0.5627	0.5734	0.7292		0.4788	0.4692	0.5508	0.5408
Heating value of H_2S-CO_2 free gas, Btu per cu ft	714	662	891		634	576	582	649
5. Tar made:								
Moisture, per cent	7.52	21.6	16.9**	24.2***	27.90	14.47	....	8.8** 37.7***
Free carbon, per cent	15.10	24.4	30.2	19.5	30.80	29.68	22.08	69.6 12.6

*Based on moisture content of 15 per cent in coal as shipped.
**From first condenser.
***From second condensor.

Are You Tied Down With PIPE *Details?*

Free yourself to go ahead with things only you can do. We have the organization, shop facilities and certainly the experience (48 years) to relieve you of all piping details from preliminary engineering to final completion. High temperature and high pressure, carbon or alloy steel piping—engineered—prefabricated—installed—guaranteed. The repeat contracts we've received prove satisfaction on large and small projects. Ask us about "who we've worked for" . . . and may we send a copy of our bulletin, "Something New in Welding," describing the Mitchell-Westport Joint, which prevents weld metal protrusions inside the pipe, without the use of backing rings.

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SINCE 1899

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PIPING FABRICATORS AND CONTRACTORS

less there is a suitable market for tar, its disposal may be achieved through gasification. This simplification in the products circumvents the necessity of developing special markets for tar obtained in low temperature distillations of coal.

In previous investigations two serious difficulties were encountered in the production of power char from finely crushed bituminous coal. These difficulties were: (1) plugging of cyclones with fine, sticky, plastic coal particles. In some earlier attempts, the products of distillation were withdrawn counter-current to the crushed coal feed and a portion of the falling coal particles was entrained in the off-gas and was deposited with the condensing tar vapors resulting in the plugging of gas lines; (2) low rates of heat transfer to the finely divided coal particles in both external and internal heating systems due to an insulating gas film surrounding each particle.

It has been possible to eliminate both these difficulties effectively in the fluidization process. Of the several systems attempted, the one involving an overhead draw-off for char, gas and tar vapors into heated cyclones has proved to be quite practical. By maintaining the cyclones at approximately the temperature of the fluid bed in the distillation retort, condensation of tar vapors has been reduced to a degree where it no longer interferes with the cyclone efficiency. The scouring action of the coarser fractions of the char product effectively prevents any "build-up" with fine, sticky coal particles passing through the plastic zone.

The rate of heat transfer in the fluid bed has been found to be almost six-fold compared to conventional coking in slot-type ovens. This improvement in heat transfer rate is believed to be due to effective scrubbing action on the gas film surrounding each coal particle in the fluid bed.

Char and the Cyclone Burner

The successful development and operation of a cyclone type furnace[3] on a commercial scale appears to open up the possibility of burning the hot char as it leaves the fluidizer system. The char product at temperatures ranging from 1292 to 1472 F (700-800 C) in the form of crude, irregularly shaped, hollow spheres, should be an excellent fuel for a cyclone furnace. When the process is operated with steam as the fluidizing agent, the char becomes activated to a certain degree. It is felt that the combustion of highly pre-heated and activated char will result in heat releases greater than 15,000 to 22,000 Btu per cu ft per hour of total combustion volume for pulverized coal burners and 30,000 to 40,000 Btu for cyclone type installations.

Another interesting feature of the char product is the ease with which it can be pulverized compared to the raw coal from which it is made. In pulverization studies on the char material, it has been found that, under similar conditions, the char will result in 16 per cent improvement in the degree of pulverization without presenting excessive abrasion difficulties.[4] It should thus be possible to run the fluid processing of coal to obtain the valuable gas and tar by-products, followed by the pulverization of char for powdered fuel burners.

Reduced Hydrogen Loss

In burning raw coal the hydrogen loss in the stack gases in the form of water vapor is quite appreciable. This loss can be curtailed and a saving of 4 per cent to 6 per cent in the overall heat balance can be realized by first distilling the hydrogen content of raw coal in the form of fuel gas, followed by the combustion of char, which is considerably dehydrogenated.

Other Advantages

As previously pointed out, another improvement is the removal of sulphur from the coal as it passes through the fluid devoletilization system. Other advantages from the burning of char will be in the form of eliminating soot deposits on tubes, permitting higher furnace temperatures, faster rates of combustion and a comparatively less visible stack discharge.

The decrease in the visibility of the stack discharge is due to two factors. First, the fuel has been rendered smokeless prior to its combustion; Second, the reduction in the hydrogen and surface moisture in the char products results in appreciably less water vapor in the flue gases. The water vapor normally present in the flue gases from the combustion of hydrogen in coal is objectionable when rendered visible by cold weather.

A further advantage in using char would be that its finely divided particles will not agglomerate as do the coal particles and this property should promote rapid and more complete combustion.

Eastern coals, which coke more easily compared to the high oxygen coals will be considerably improved in their burning qualities in pulverized form on being converted into a char first. The high-oxygen coals will be improved in heating value because of the removability of oxygen in the devolatilization step.

Further possibilities in the utilization of char as a smokeless fuel in briquette form, both in hand fired furnaces and automatic stokers are indicated. Suitably sized briquettes for these purposes have actually been prepared and await field testing.

Beyond the processing of coal to produce power char, fuel gas and smokeless briquettes lies the field of making synthesis gas from char or the fuel gas. Synthesis gas, a mixture of carbon monoxide and hydrogen, is a starting material for the production of liquid fuels, lubricating oils and valuable chemicals. (See POWER PLANT ENGINEERING, August, 1947, page 108).

The application of the fluid technique to our bituminous coals has been demonstrated successfully on an experimental scale, hence the time may not be far off when the above predicted scope of tomorrow's power plant may be actually realized.

Literature Cited

[1] Fluid Devolatilization of Coal for Power Plant Practice; A. D. Singh and L. J. Kane., contributed by the Fuels Division, and presented at the Semi-Annual Meeting ASME, Chicago, Illinois, June 15-19, 1947.

[2] *Ibid.*

[3] The Horizontal Cyclone Burner, by A. E. Grunert, L. Skog and L. S. Wilcoxson, presented at Annual Meeting ASME, New York, N. Y., December 2-6, 1946.

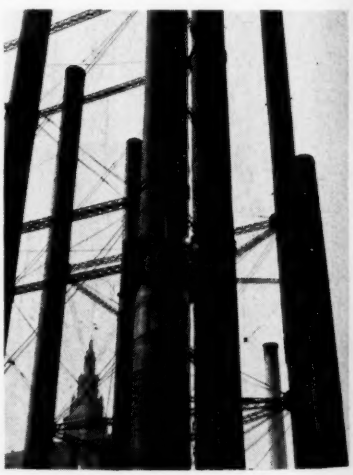
[4] Private correspondence.

TALL SMOKESTACK IS REINFORCED

AS PART of the modernization of the Canal Road central steam heating plant of the Cleveland Electric Illuminating Company in Cleveland, a smokestack has been reinforced by welding steel plates to the steel shell from the foundation of the stack up to a 60 ft height. The top part of the stack, which is 120 ft high, was similarly reinforced several years ago.

The reinforcement of the stack by the welding process was determined by the company's engineers to be the most economical and efficient method of maintaining it.

The shell was covered with ¼-in. steel plate, cut and rolled so that four sections of plate would circumscribe the 7-ft, 6-in. diameter of the stack. The joints were beveled 60 deg and the sections were welded together with shielded arc electrodes, each joint being made first with a stringer pass and then with a weaving bead. The new exterior was then covered with red lead and black corrosion-resisting paint.



"HAS OPERATED 99% OF THE TIME SINCE 1939"

reports the City of St. Mary's, Ohio, of their first 2500 K W Worthington Turbine Generator.

Mr. George Probst
Worthington Pump and Machinery Corporation
Steam Turbine Division
Wellsville, New York

Dear Mr. Probst:

You will be interested, I'm sure, to learn that our new 2500 KW Worthington Turbine Generator has been running continuously since it was put on the line about six months ago.

It's been eight years now since our original 2500 KW Worthington unit was started and it has operated 99% of the time ever since. On a number of occasions, it has carried loads of 3000 to 3500 KW for periods of three to four hours. We run both units a large portion of the time and they parallel very nicely.

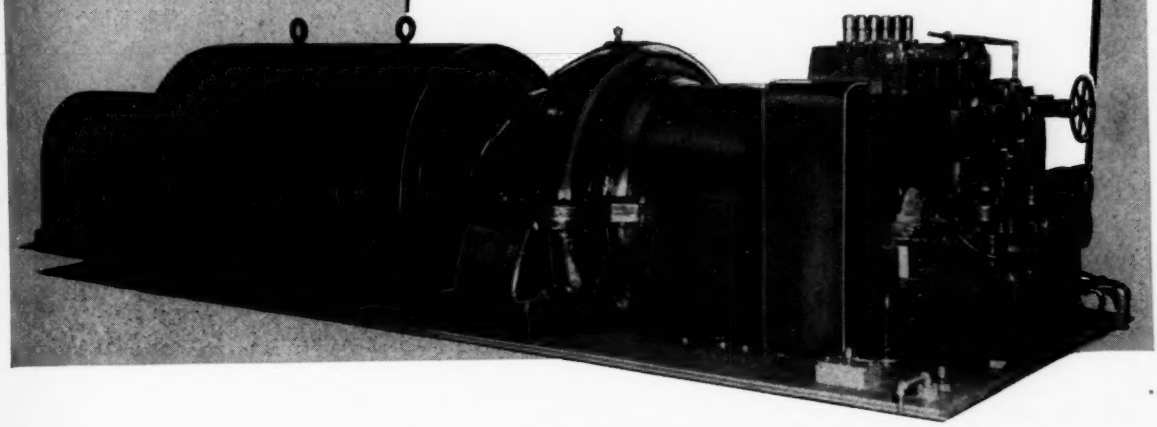
In fact, we do so well with these Worthington units that we would be glad to show them in operation to any of your prospective customers who care to visit our plant.

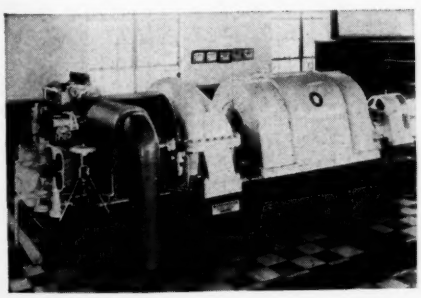
Very truly yours,
CITY OF ST. MARY'S

J M Hageman

City Engineer and Director
of Service and Safety

New 2500 KW Worthington Turbine Generator recently installed in municipal power plant of the City of St. Mary's, Ohio.





2500 KW Worthington unit installed in 1939. Turbine, straight, condensing type, operates on 400 lbs. steam pressure, 750 degrees total temperature and exhausts into a vacuum of 28"

Many similar reports from power users throughout the country testify to the trouble-free, cost-saving performance of Worthington steam turbine equipment. In your own turbine problems, Worthington specialists are always available for expert technical advice. And for further proof that *there's more worth in Worthington*, write for fact-full literature. *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

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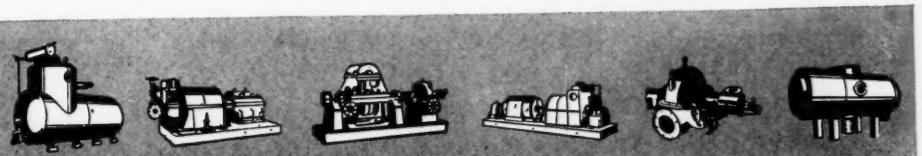


How to Store and Handle Fuel Oil

Satisfactory operation of industrial oil firing installations depends on proper accessories as much as on selection of oil burner . . . This article shows how to store oil, pump it and heat it and deliver it at desired conditions to the burners . . . Many troubles caused by insufficient storage capacity . . . Use at least two tanks, so oils can be stored from different sources when they are incompatible . . . How to determine when oils are incompatible . . . Simple rules for mixing oils . . . Liquid level gages for storage tanks . . . Piping for fuel oil . . . Pumping equipment should be duplicate, both electric and steam driven . . . Strainers . . . Oil heating . . . Valves, controls, unit assemblies

By R. J. BENDER *Assistant to President, Sinclair Petroleum Co., New York*

IN A PREVIOUS article* giving details of various types of fuel oil burners, it was pointed out that satisfactory operation of an oil-firing installation depended as much upon the judicious selection of all the accessory equipment as upon the choice of the oil burner best fitted for the job. This article attempts to clarify some of the details that must be considered, especially in the storage of fuel oil and the system of piping, valves, heaters and controls employed to deliver the oil to the burners.

*Tailor-Made Industrial Oil Firing, by R. J. Bender; POWER PLANT ENGINEERING, March, 1947.

Storage of Fuel Oil

The size of the fuel oil storage tanks must be adequate to the installation. Many of the difficulties encountered these days can be traced to a general insufficiency of storage capacity throughout the country. If fuel oil could be stored during the warm months of the year to provide a convenient flywheel, at least for the first five months of the heating season, conditions would be much improved and industrial plants would hardly notice the added burden of their "heating load." Unfortunately there is not, at present, enough steel available to make up, on the spur of the moment, for several years of shortsighted planning.

Consumers using large quantities of fuel oil would do well to install at least two tanks, each having enough capacity for a full delivery. A typical installation of this kind is shown in Figs. 2 and 3. That procedure would assure them, when fuel is in short supply and they must shop around for a load, that they will not be compelled to blend together two

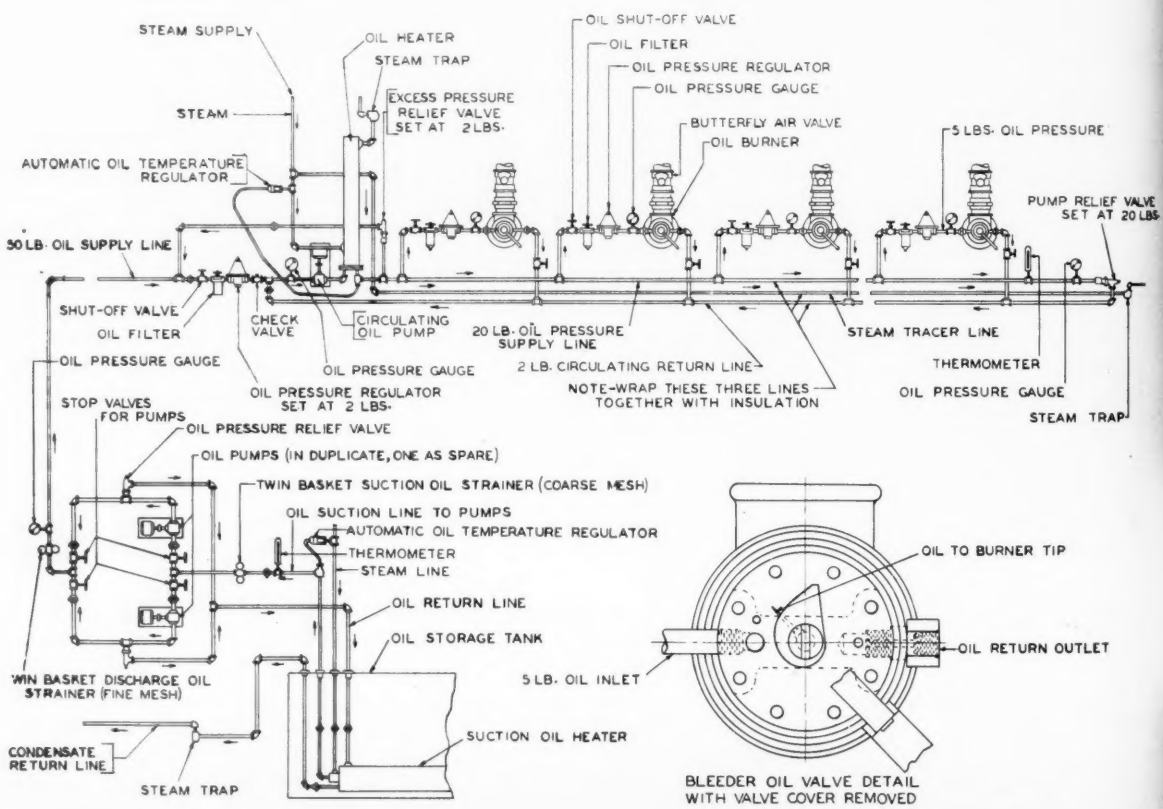
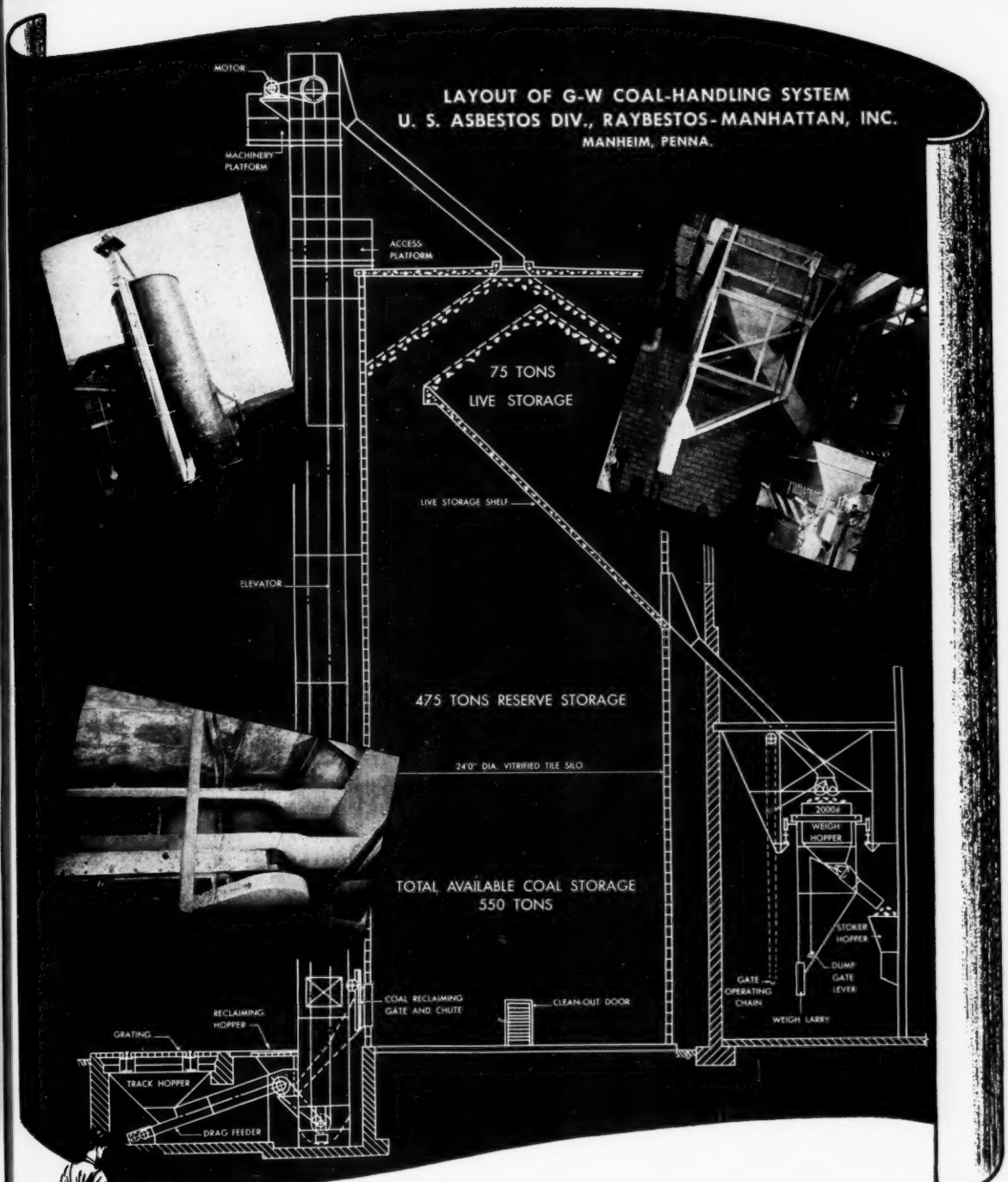


Fig. 1. Oil circulating and heating system. The hot oil in excess of the burners' requirements is recirculated into the oil line. (Courtesy Hauck Mfg. Co.)



A complete system of coal-handling: track hopper, elevator, silo—and all connecting equipment for mechanically transporting coal through the system to the stoker hoppers—all G-W. Basically simple . . . *your* conveyor can be apron, reciprocating or drag feeder; elevator—gravity or centrifugal discharge; silo—concrete, tile or steel; stoker served by spout, screw conveyor or weigh larry.

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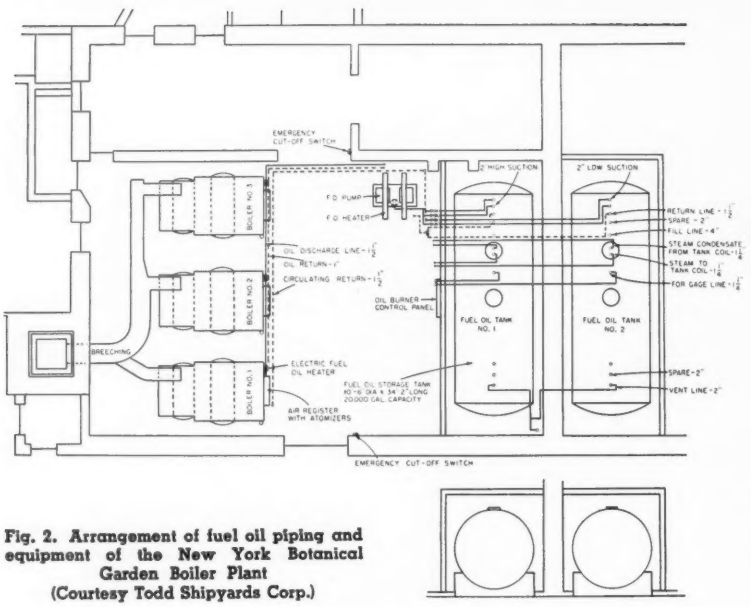

EMERGENCY CUT-OFF SWITCH
2" HIGH SUCTION
2" LOW SUCTION
F.O. PUMP
F.O. HEATER
RETURN LINE - 1½"
SPARE - 2"
FILL LINE - 4"
STEAM CONDENSATE FROM TANK COIL - 1½"
STEAM TO TANK COIL - 1½"
FOR GAGE LINE - 1½"
OIL DISCHARGE LINE - 1½"
OIL RETURN - 1"
CIRCULATING RETURN - 1½"
OIL BURNER CONTROL PANEL
BOILER NO. 3
BOILER NO. 2
BOILER NO. 1
BREECHING
ELECTRIC FUEL OIL HEATER
FUEL OIL STORAGE TANK NO. 16 DIA. × 34' LONG 20,000 GAL. CAPACITY
AIR REGISTER WITH ATOMIZERS
FUEL OIL TANK NO. 1
FUEL OIL TANK NO. 2
SPARE - 2"
VENT LINE - 2"
EMERGENCY CUT-OFF SWITCH

Fig. 2. Arrangement of fuel oil piping and equipment of the New York Botanical Garden Boiler Plant (Courtesy Todd Shipyards Corp.)

THE AUTHOR

Rene J. Bender, known to many as "Chief" Bender, has been connected with Sinclair Refining Co. in various engineering capacities for 15 years, lately as assistant to the chief consulting engineer. In sending us this article, he tells us that he has just been made assistant to the president of Sinclair Petroleum Co. and is leaving for Addis Ababa, Ethiopia, where he will represent his company.

Mr. Bender was for 10 years editor of the Sinclair *Firebox* in Chicago. During World War II, he served for two years in the U. S. Navy overseas. On his return, he was assigned to the home office of the company in New York. He is the author of many technical papers presented before engineering societies and published in the technical press.

fuel oils, each one excellent in quality, but incompatible with each other.

Great progress was made during the war in the understanding of "fuel oil incompatibility," thanks to the work of the U. S. Navy, which has to accept supplies of oils from the most variegated origins all over the world. An abbreviated analysis of the oil permits detection of its nature and of the refining process to which it was subjected. The needed specifications are: the gravity API, the Conradson Carbon Residue, the pour point, the aniline point and the percentage of fuel soluble in benzol and in cyclohexane.

When and How Oils Can Be Mixed

These data will tell whether the fuel is straight-run or cracked, give an approximation of the degree of cracking, and of the percentage of paraffinic versus aromatic hydrocarbons present in the "cutter stock" and in the tar. Then some simple rules as follows, can be applied:

1. Straight-run residue can be mixed with any straight-run product, either residual or distillate cutter stock, without precipitation. There may be, in certain cases, a separation of wax.

2. Cracked residue can be mixed with straight-run residue on account of the "peptizing" action of the straight-run asphalt.

3. Cracked distillate can be added to a blend as a third constituent, and the resultant product will be stable, on account of the aromatic nature of the cracked oils, which favors colloidal suspension.

4. A cracked residual oil is incompatible with a straight-run distillate on account of the paraffinic nature of the latter, which causes the colloidal solution to segregate and form sludge.

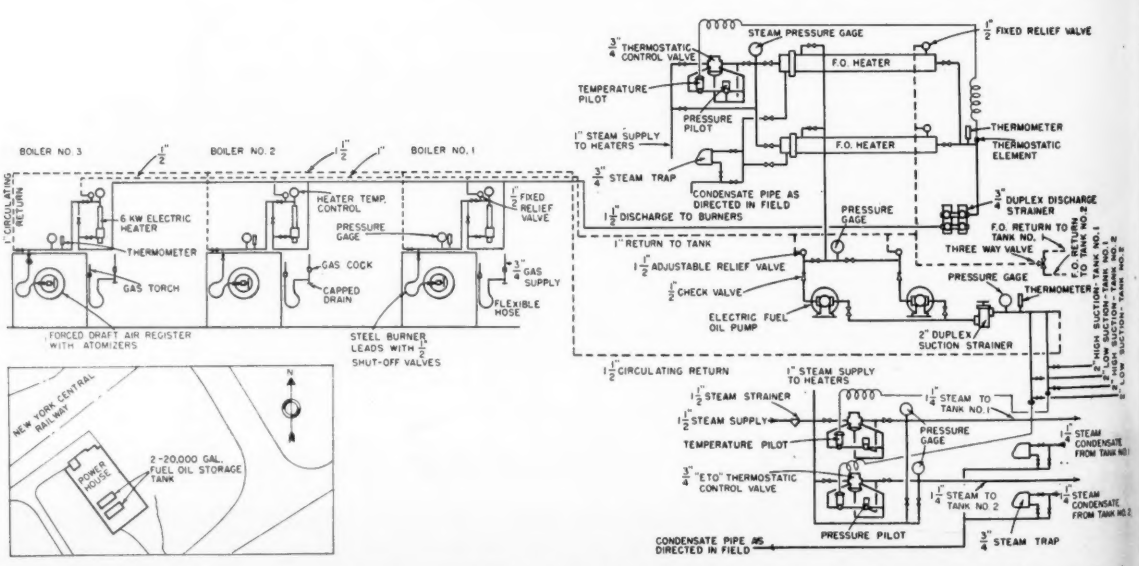
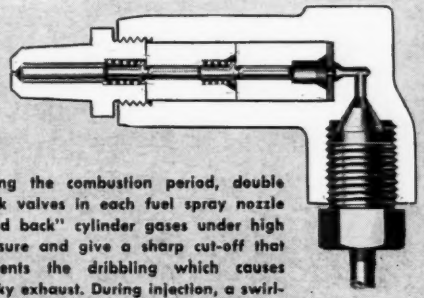


Fig. 3. Arrangement of fuel oil piping and equipment of the New York Botanical Garden boiler plant—(Courtesy Todd Shipyards Corp.)

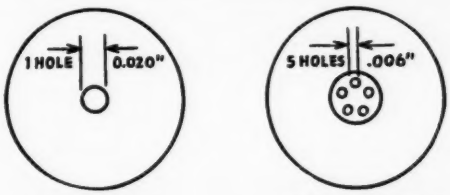
TYPE "S" *Injection System*

GIVES BETTER COMBUSTION AND LOWER MAINTENANCE



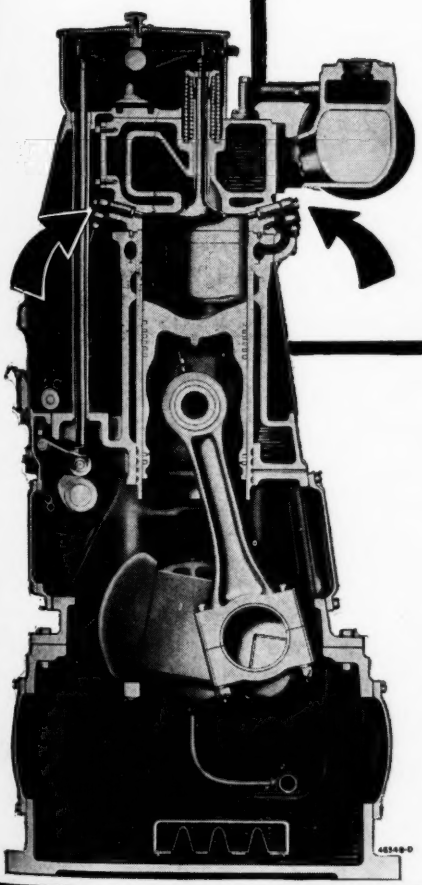
During the combustion period, double check valves in each fuel spray nozzle "hold back" cylinder gases under high pressure and give a sharp cut-off that prevents the dribbling which causes smoky exhaust. During injection, a swirling motion is imparted to the sprays emerging from the nozzle tips for complete fuel dispersion.

ADVANTAGES OF THE SINGLE HOLE INJECTION NOZZLE



I-R NOZZLE TIP **ORDINARY NOZZLE TIP**

The single large-diameter hole will pass foreign particles many times larger than the multi-hole, small-opening nozzle. Because of this feature, plugging of the nozzles is almost non-existent. To the experienced Diesel operator and maintenance man, this advantage is self-evident.



In 26 years of pioneering in solid fuel injection, Ingersoll-Rand has perfected an injection nozzle which is outstanding not only for its primary purpose of injecting fuel, but also for its simplicity and low maintenance.

These are the principle features of the Type "S" system:

1. **Location of the nozzle permits its removal without disturbing the cylinder head, the fuel injection pump, or its actuating mechanism.**
2. **Design of nozzle permits it to be completely taken apart for inspection or cleaning by unscrewing the nozzle tip.**
3. **The single large-diameter hole in each nozzle prevents plugging of nozzle.**
4. **Double check valves prevent dribbling.**

Ask for bulletin 10,310. It gives the complete story of these 720-rpm, 4-cycle Diesels which Ingersoll-Rand builds in sizes from 225 to 600 hp. For information on the "Super S" turbocharged Diesels ask for Form 10,311. This engine is built in 6, 7 and 8 cylinder sizes from 675 to 900 hp.

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Fig. 4. A liquid level gage. (Courtesy Liquidometer Corp.)

Explanation of Balanced Hydraulic Transmission Used in Luiqidometer

All four bellows are fixed at their outer ends. Bellows C and E are linked together, as are bellows D and F. Bellows C and D are connected by tubing, as are bellows E and F. The two circuits are filled with liquid. When the float moves down, tank end bellows C compresses and displaces liquid, causing dial end bellows D to expand. Simultaneously, tank end bellows E expands, taking in liquid, causing dial end bellows F to compress. When float moves up, the action is reversed. The twin hydraulic circuits and an ingenious link arrangement at the dial end provide a completely temperature compensated system.

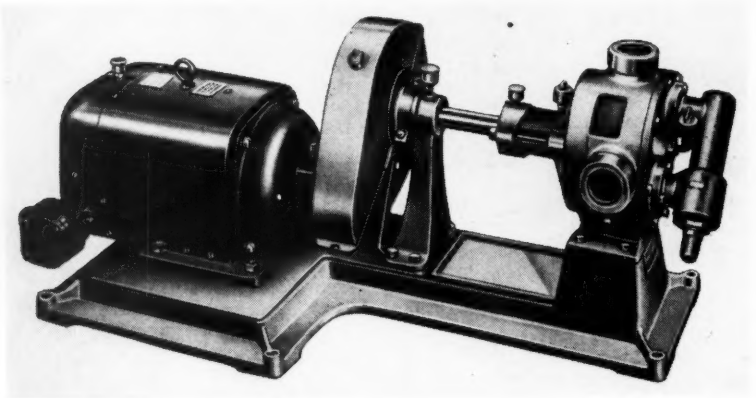

Fig. 5. Viking positive displacement rotary oil pump electrically driven through two annular gears

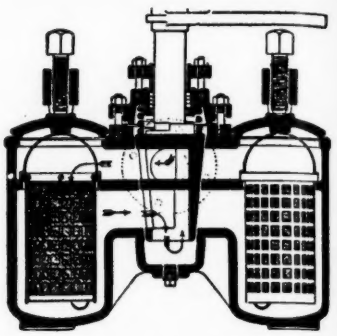

Fig. 6. Duplex oil strainers with control lever to switch oil flow from one side to the other

Level Gages

While the only completely foolproof manner of checking the fuel level in a large tank is by sounding with a stick or tape, it is convenient to have, for current use, some type of float gage connected to an indicating dial. An attractive design consists of a float connected by hydraulic transmission to a dial, which may be located at some distance from the tank, in the pump house, or in the operator's office. The principle of operation of such a gage is shown in Fig. 4.

Piping must be correctly designed and proportioned to obtain correct velocities and avoid excessive friction losses. Suction velocity is generally in the order of 0.5 to 0.6 ft per sec for heavy oils; and pump discharge velocity 1 to 2 ft per sec. In installations where a sizable quantity of oil returns to the tank, the return line must be large enough to avoid excessive pressures on the pressure control valve.

Portions of the piping immersed in the tank must be of the same type of metal as the tank itself in order to avoid electrolytic attack of the piping. Standard black steel, with standard cast-iron flanged fittings, is the best material for such lines and extra-heavy black seamless steel with extra-heavy malleable iron fittings for discharge lines. Clean galvanized iron is also frequently used.

Pumping Equipment

It is always advisable to have duplicate pumping units. As a further safeguard against power shutdown, it is well to install one unit electrically-driven and the other steam-driven, either with a reciprocating engine or a steam turbine. Each unit should be large enough to carry the maximum plant load without pressure reduction. Pumps should preferably be located near the stor-

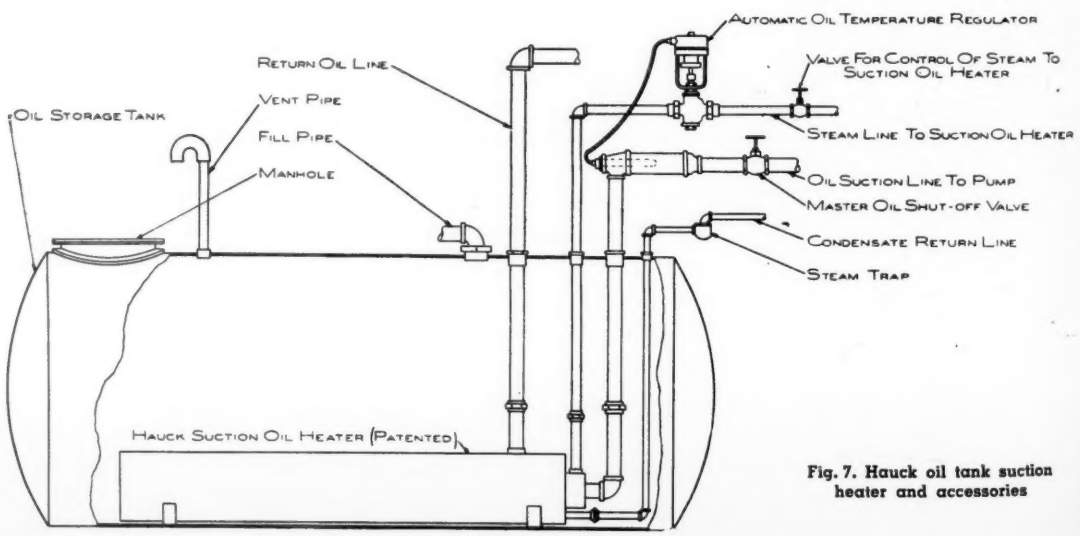

Fig. 7. Hauck oil tank suction heater and accessories

Take a *good* look at a *Liability*

Any boiler plant becomes a liability when improper water conditioning eats up profits by causing excessive blowdown, carryover . . . scale.

But this liability can be turned into an asset with *correct* water conditioning . . . a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .
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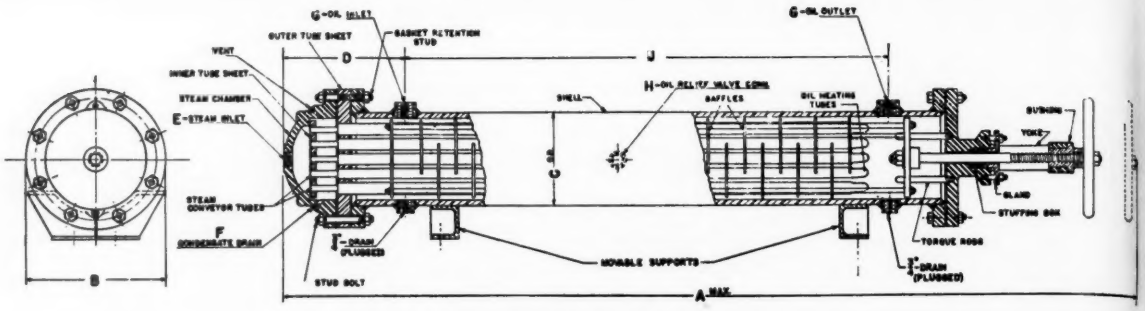

Fig. 8. Paracoil cleanable tubular oil heater

age tanks, especially when a lift is required. This minimizes the hazard of excess vacuum caused by a long suction line, with possible vapor locks; it reduces the chances for air leaks. For a high lift, a foot valve should be installed in the tank at the suction line inlet. The suction line must be absolutely tight. This essential condition applies, obviously, to all accessory equipment on the suction line, such as valves and strainers.

To start and operate steam pumps, the instructions supplied with the equipment, relative to adjustments, lubrication and general percautions, should always be carefully understood and followed. Oil pressure in the system is regulated by the pump governor for steam-driven pumps. In electric-driven jobs, the main pressure control valve returns to the storage tank or preferably to the heater inlet that portion of the oil not used in the burners, as in Figs. 1 and 3.

In certain installations when contamination with water is to be expected, particularly in marine jobs, there is a high and a low suction line interconnected in such a way as to make it possible to use one pump to discharge sludge or water from the tank overboard, while the other pump carries on its task of supplying oil to the burners.

Strainers

Duplex strainers, Fig. 6, are standard equipment on the suction line as well as on the discharge line from the pumps. The mesh of the former is ordinarily coarser than the mesh of the discharge strainer, the latter being located on the line following the oil preheater and after the oil has become more fluid. Suction line strainers have holes from 1/16 in. for heavy oils to 1/32 in. for light oils, while discharge oil strainers have holes from 1/32 in. for heavy oils to 1/64 in. for light oils.

Additional "plate filters" may be installed immediately before the oil burner control valves. They can be cleaned without interrupting the flow of oil to the burners. Strainer caps and plugs must be maintained tight.

Here again it is advisable that strainer baskets be of the same type of metal as their bodies, to avoid electrolytic corrosion.

Oil Preheating

The viscosity of a fuel oil varies greatly with changes of temperature. Viscosity not only controls the rate of flow of the oil, but on it also depends the proper atomization of the fuel in mechanical atomizing burners. It is therefore necessary to preheat the oil: 1) in order to allow its easy pumping through the system, 2) in order to bring it to the viscosity most favorable to its complete atomization. The preheating is generally accomplished in two stages.

Oils too viscous to flow freely at the temperatures prevailing in winter in the storage tank must be preheated in the tank, by means of a steam heater enveloping the bottom of the suction pipe, as in Fig. 7. The Suction Heater, as it is called, preferably equipped with an automatic temperature regulator, brings the oil to a temperature satisfactory for its circulation. In certain installations, the return oil line is connected directly to this heater, as in Fig. 1, so that the warm return oil is mixed with the cold oil entering the heater.

Steam pressure may be from 1 to 200 psi., for an oil temperature rise as high as 175 F. A steam trap on the condensate line is, of course, an indispensable accessory, as shown in Fig. 7.

The second oil preheating, for the purpose of reaching a viscosity favorable to best atomization, can be accomplished in an electrical preheater, a steam preheater or better still, a comibnation of both heaters in series. Figure 8 shows a typical cleanable oil heater.

An automatic temperature regulator Fig. 3, and two thermometers, one before and one after the preheaters, are, of course, advisable for satisfactory operation. In large capacity plants especially when the load varies greatly it is often advisable to have three preheaters instead of two, each of the three capable of carrying one-half of the maximum load, so that, on low rate operation, one heater alone can be used, with higher oil velocity through the heater. This keeps the heaters clean much longer.

Steam pressure from 1 to 125 psi. will raise the oil temperature by as much as 225 F. Optimum temperature, varying with every type of fuel oil, is that which will bring its viscosity to 150 ssu (Saybolt Seconds Universal). Steam atomizing and rotary cup burners are not as sensitive to viscosity changes as mechanical atomizing burners, and require less preheating.

A steam condensate trap is indis-

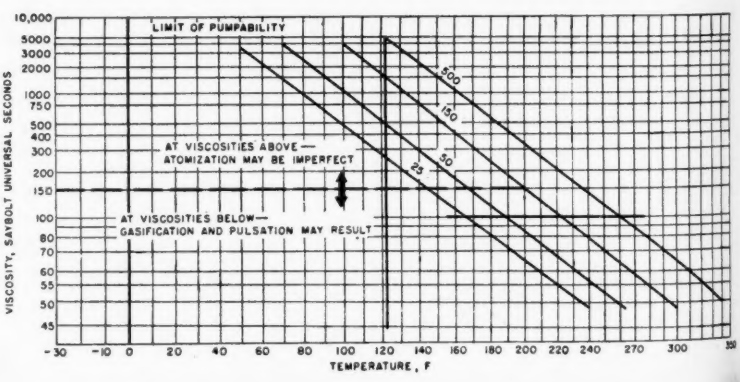

Fig. 9. Chart for the determination of optimum fuel oil temperature

This is ASTM Standard Viscosity-Temperature Chart for Liquid Petroleum Products (D 341-41) Chart B: Saybolt Universal Viscosity, Abridged. Four curves shown are indicative of oils with viscosities of 25, 50, 150 and 500 seconds Saybolt Furol at 122 F

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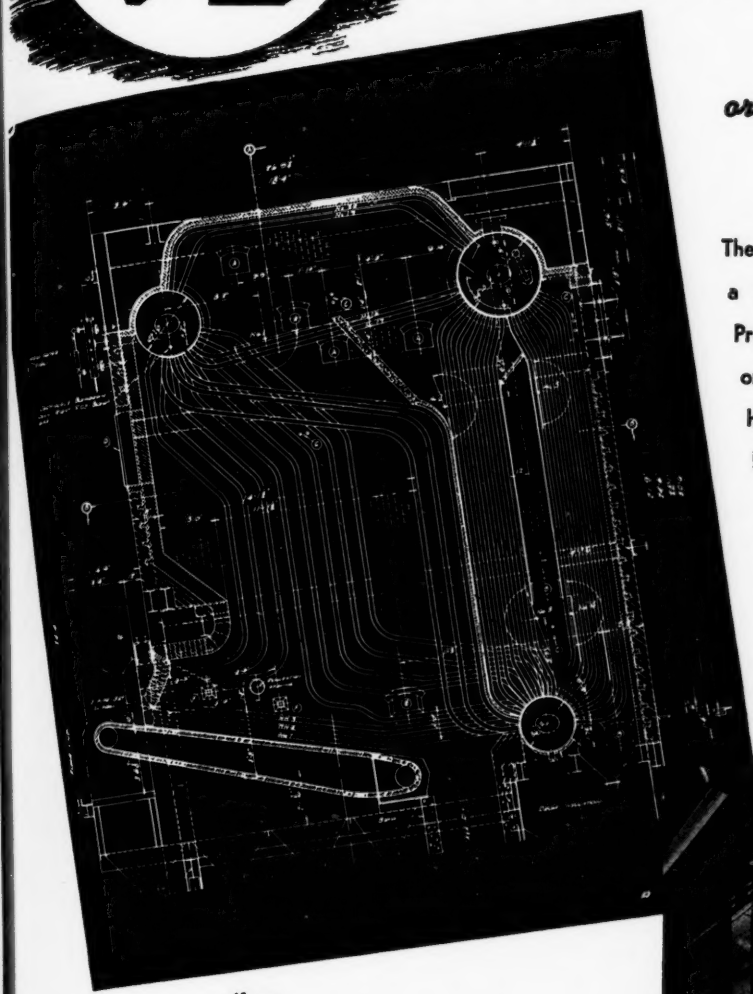
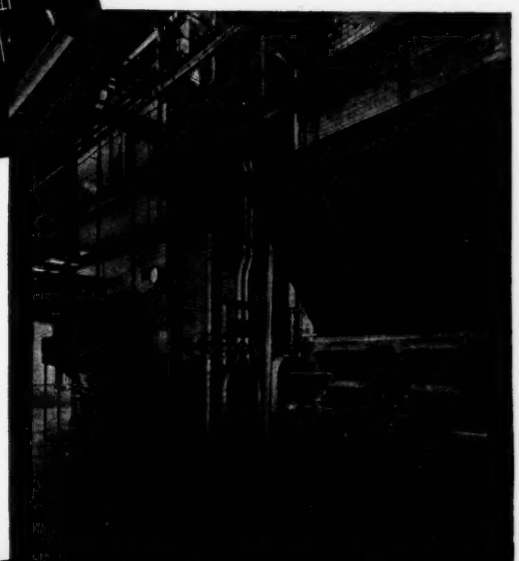


Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.



Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

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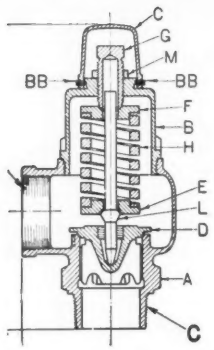

Fig. 10. Typical relief valve

pensable equipment on the condensate line from the preheater. Oil pressure drop through heaters should never be over 5 psi, and preferably should be maintained at 2 to 3 psi.

To minimize baking of oil on heater surfaces it is advisable, when turning off the preheaters to shut off the steam first, and the oil a little later.

Valves

It is sometimes as confusing to examine a flow diagram of an oil burning installation as it is to observe the actual installation. This results from the large number of valves necessary for safe operation. The following valves are considered essential for good practice.

Shut-off valves:—These must be installed wherever it is desirable to isolate a portion of the equipment. A master shut-off valve is always located on the suction line leaving the storage tanks. But no shut-off valve should ever be installed on the return line between the pumps, the relief valve and the tanks, for obvious safety reasons.

Oil pressure relief valves:—These valves, of adequate capacity, must be installed on the main lines immediately following the pumps, to relieve the entire pump discharge back to the tanks in case any valve in the system is closed. A typical relief valve is shown in Fig. 10. The relief pressure should be the pressure used on the system. This valve is generally accompanied by a pressure gage. A similar valve should be installed in connection with each oil preheater to take care of the expansion of the oil in case both sides of the preheater are accidentally closed by shut-off valves.

Magnetic two-way valves, thermostatically controlled:—The purpose of these valves is to keep the oil circulating through the preheaters and the system until such time as the viscosity is correct for atomization; then the valves open, admitting oil to the burners.

Automatic safety shut-off oil valves:—Either of the mechanical or the solenoid type, they are used to shut off the oil from the burner in case of failure of air, steam or electricity. These valves must be reset manually.

Accessories

Besides the equipment discussed above, it is advisable to install:

Pressure gages before and after the discharge strainer, to get an idea of the gradual pressure drop as the strainer becomes loaded.

Oil control regulating valves on the burners, preferably with an indicator.

An air chamber on the discharge line from the pumps to the heaters to eliminate pulsations from the reciprocating action of the pumps.

Steam strainers.

Fuel oil meters, ahead of the burners.

Most of the equipment described may be concentrated as in Fig. 11, in one compact unit conventionally located between storage tanks and oil burners. In that case, the only additional equipment required is that for the handling of the air for combustion:—fans or turbo-compressors, air ducts and air control valves.

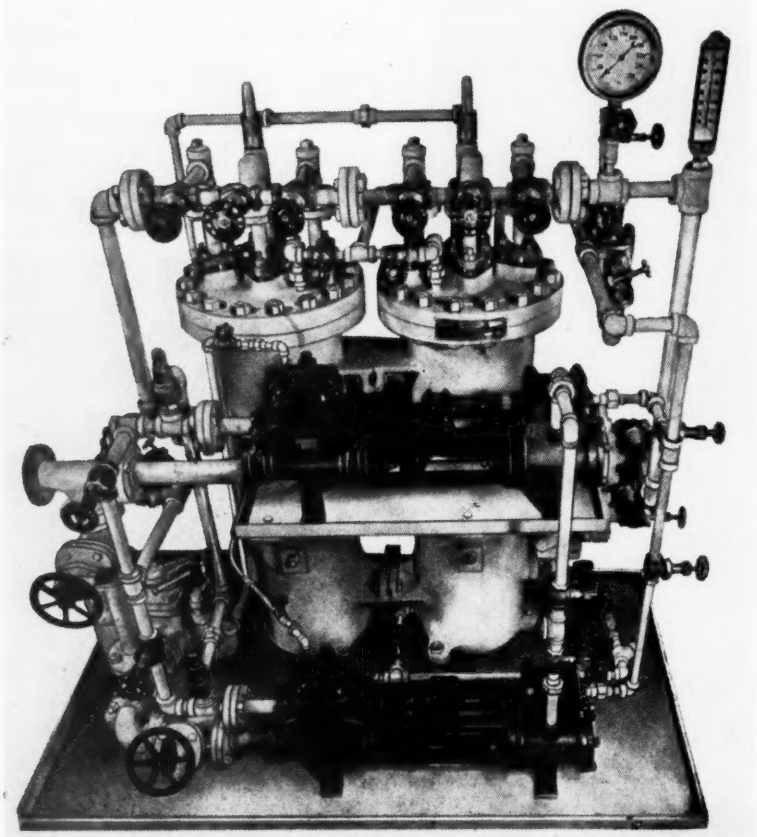

Fig. 11. A Todd pumping, heating and straining unit, with two preheaters, duplicate steam pumps, and full set of accessories

SMOKE ABATEMENT DEMAND ON INCREASE

"THE DEMAND for smoke abatement in the cities throughout the country is increasing daily," said H. B. Lammers, director of engineering for the Coal Producers Committee for Smoke Abatement, recently. "But except in the isolated cases, or where the problem has entered the realm of politics, there no longer is the fervent belief that smoke abatement can be achieved by pressing a button or passing a law.

"Slowly but surely the truth about smoke abatement is being accepted. And the truth is that the problem is an engineering one, and one that must be solved plant by plant and area by area," Mr. Lammers continued.

"Rightly or wrongly," Mr. Lammers said, "our cities did practically nothing about smoke abatement until recent years. During all decades of the industrial development in this country, plants were installed without regard to the emission of smoke or even without regard to efficient operation.

"It must be plain to anyone who studies the smoke problem, even superficially, that all these mistakes cannot be corrected over night. It must also be plain that a plant installed before smoke abatement was even mentioned cannot now suddenly be hailed into court and ordered to either abate the smoke forthwith or be sealed."

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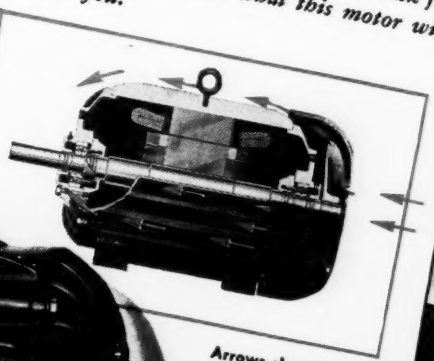

Arrows show path of cooling air over exterior of frame.

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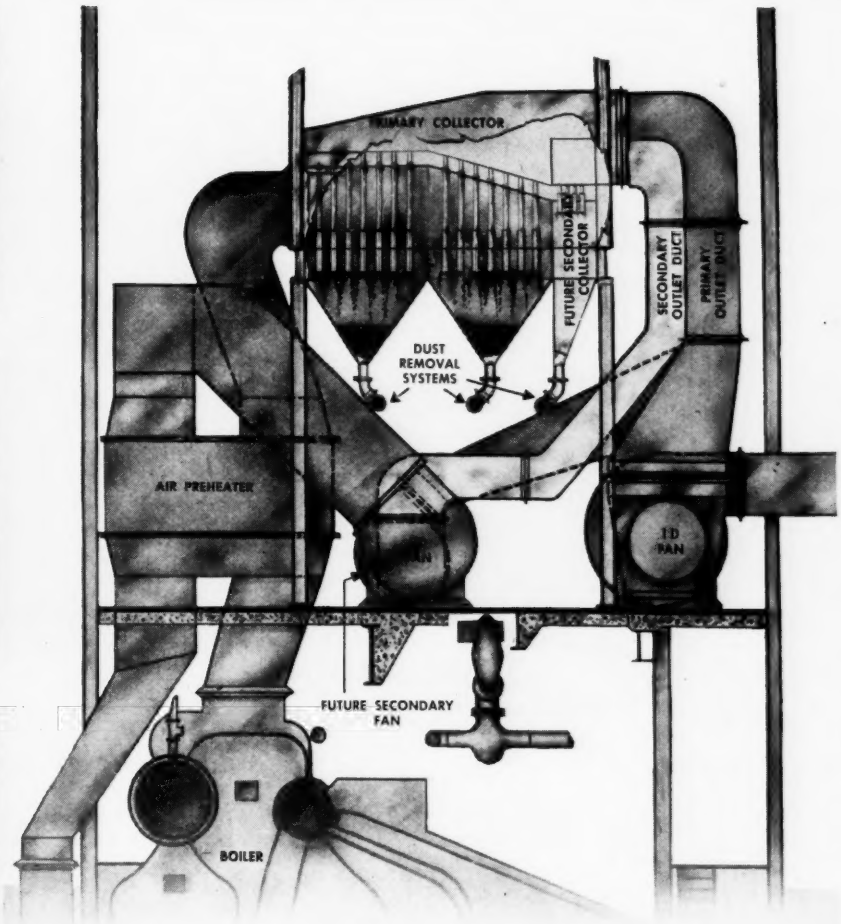

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Note the illustration. The dark portion represents the primary tubular dust collector now installed (with a second installation now being constructed). The light portion represents the secondary or Duplex section, which can be installed in the future, if required.

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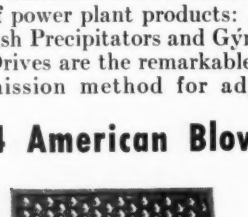

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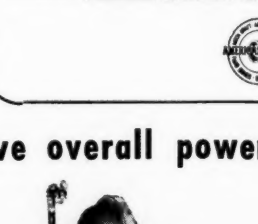

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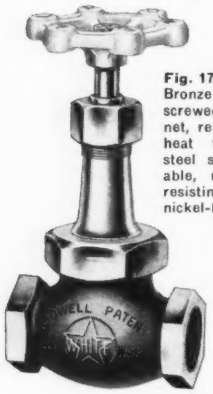

Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel bronze disc.

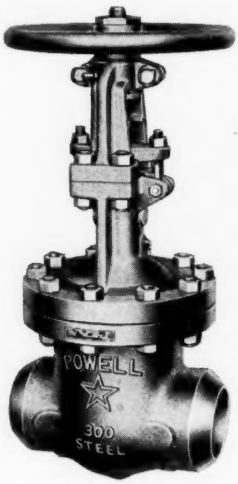

Fig. 3003 W. E. — Class 300-pound Cast Steel Gate Valve with welding ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

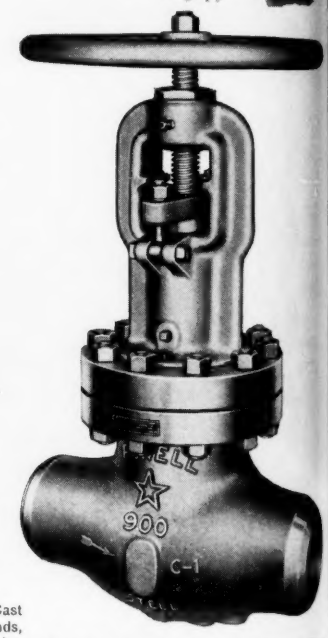

Fig. 9026 W. E. — Class 900-pound Cast Steel Globe Valve with Piston Guided Disc. Has welding ends, outside screw rising stem and bolted flanged yoke.

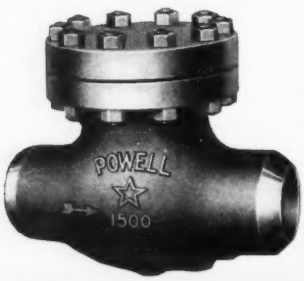

Fig. 1365 W. E.—Class 1500-pound Cast Steel Horizontal Lift Check Valve with welding ends and bolted flanged cap.

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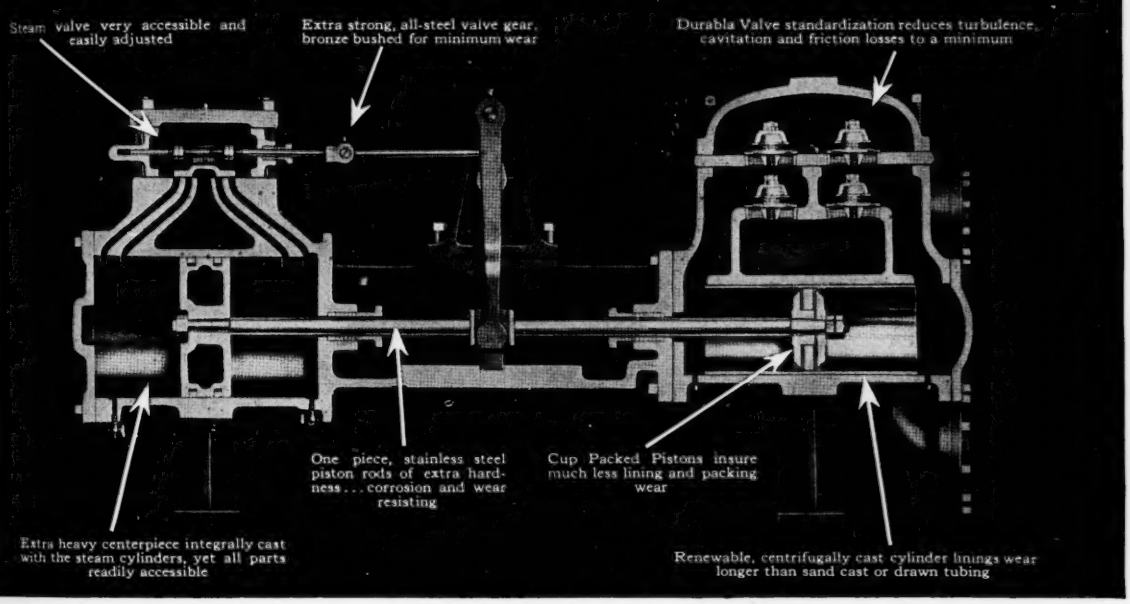
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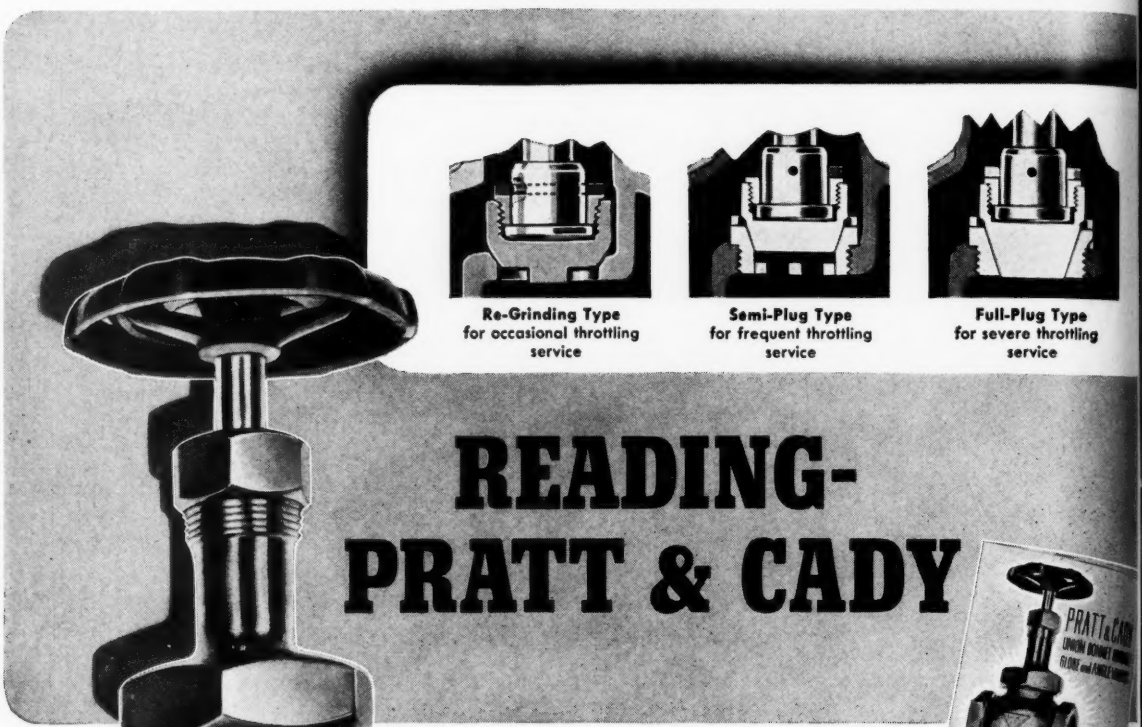

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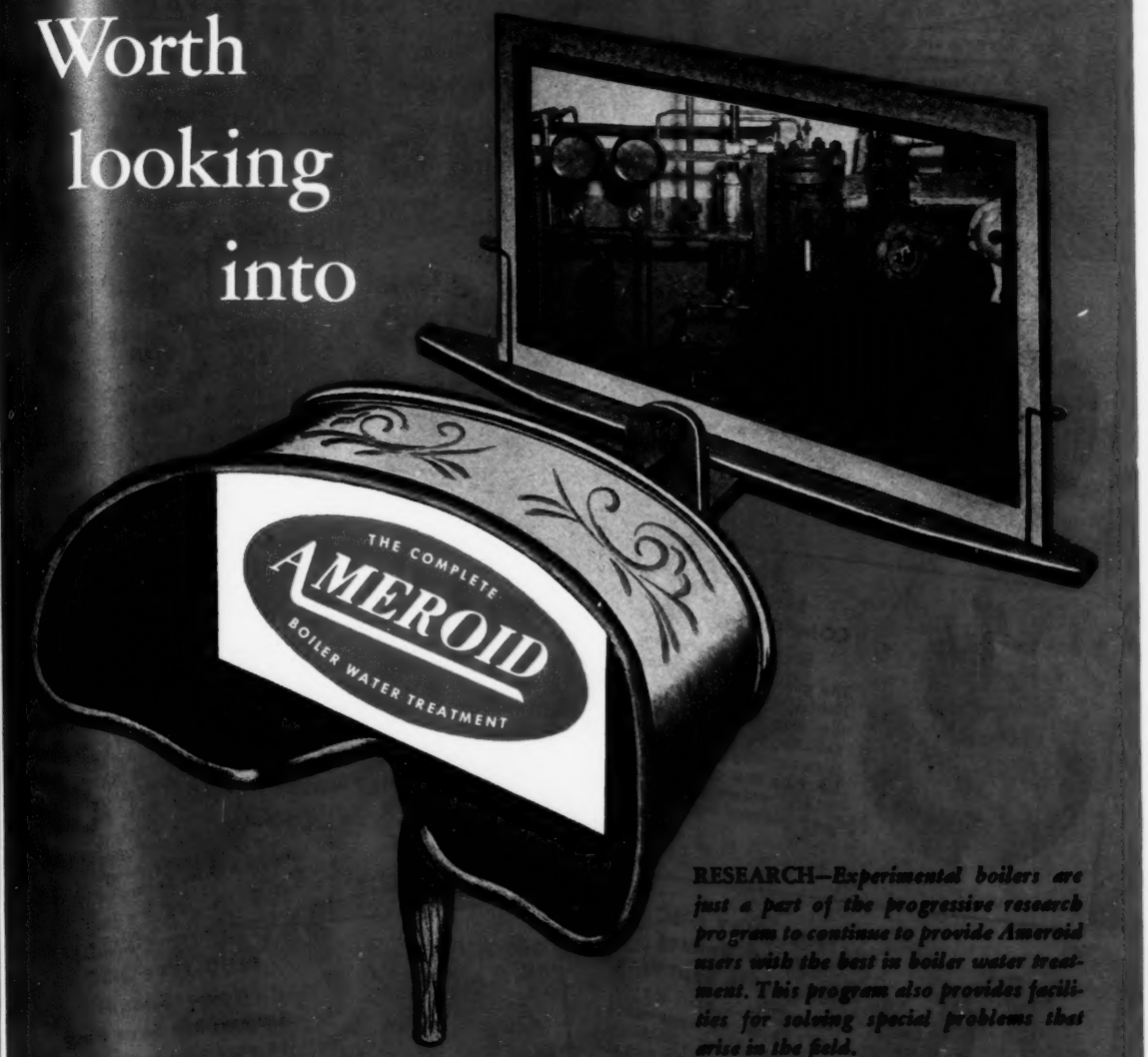

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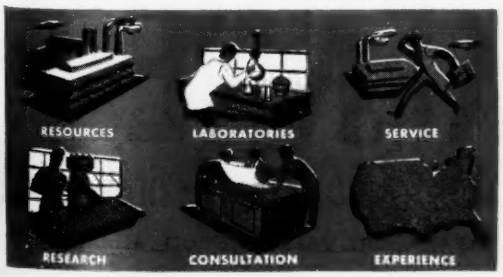

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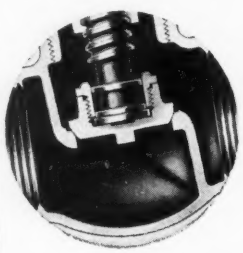
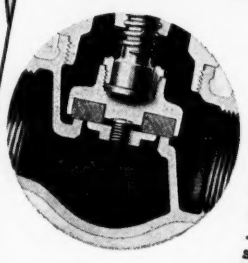
Guide for Selecting KENNEDY BRONZE GLOBE VALVES



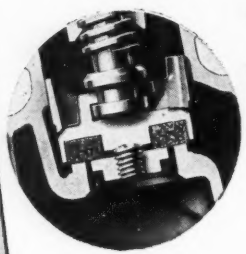
BRONZE DISC
Screwed Bonnet

This valve is designed for standard pressure, general service. Like all Kennedy Bronze Globe and Angle Valves this type can be repacked under pressure when wide open.



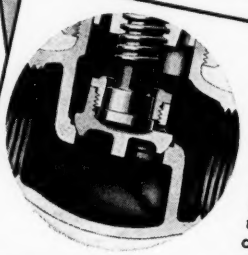
RENEWABLE COMPOSITION DISC
Screwed Bonnet

The discs in these standard-pressure valves are built to standard dimensions . . . those carried in stock by all supply houses. Kennedy offers various compositions . . . each selected to meet specific operating conditions. The exceptionally high raised seat assures longer disc life.



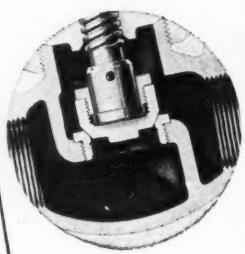
RENEWABLE COMPOSITION DISC
Union Bonnet

The convenient Slip-on Disc Holder speeds up renewing the disc on these 150 lb. Kennedy valves. This holder is accurately guided in the body by four guided prongs which maintain alignment and prevent binding.



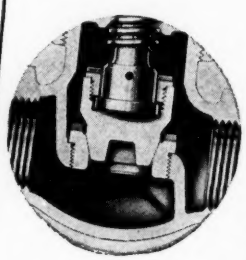
REGRINDING DISC
Union Bonnet

The discs of these 125 lb. and 200 lb. valves are designed to permit repeated regrinding . . . without removing the valve from the line. The body, bonnet, union bonnet ring and disc are made of the same metal as used for 300 lb. Kennedy valves.



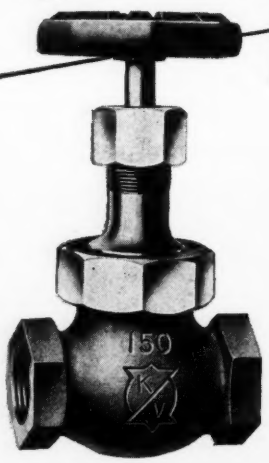
FULL-WAY DISC
Union Bonnet
Renewable Seat Ring

These 200 lb. and 300 lb. valves have renewable discs and seat rings of tough, wear resisting nickel-copper alloy. They can be furnished in special alloys to meet unusually severe service conditions.



PLUG-TYPE DISC
Union Bonnet
Renewable Seat Ring

The extra wide seating surfaces of these 200 lb. and 300 lb. Kennedy valves make them highly resistant to wire drawing. The plug-type disc design assures precise throttling control. Nickel-copper alloy for discs and seat rings are standard. Special alloys for unusual service conditions are available.



In addition to these bronze globe and angle valves, the extensive Kennedy line also includes bronze gate and check valves, iron body gate, globe, angle and check valves, malleable iron and bronze screwed fittings, and cast iron flanged fittings and flanges. Write for Catalog 63, describing all Kennedy products.

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900,000 lb/hr

COCHRANE ATOMIZING DEAERATOR

CONSTANT expansion of the power plant facilities of the Paulsboro, N. J., plant of the Socony-Vacuum Oil Company culminated in the installation of four new 125,000 lb/hr, 900 psi boilers from July, 1943 to August, 1945. As the greater part of the steam is used in process, steam returns are small and about 75% of the boiler feed water is make-up. This is taken twice daily from the Delaware River on which the plant is located, and the water for these high pressure boilers is chlorinated, demineralized and then passes to a Cochrane Atomizing Deaerator of 900,000 lb/hr capacity. The atomizing deaerator is especially suited to an installation of this kind as water treated in this manner is apt to be corrosive in its action on tray-type deaerators. In the Cochrane Atomizing Deaerator, trays are eliminated and the water is deaerated by means of a high velocity steam jet which finely divides or atomizes it. The process is completely described in Cochrane Publication 4160, which will gladly be sent on request.

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COCHRANE CORPORATION
3123 N. 17th St., Philadelphia 32, Pa.

COCHRANE COLD WATER DEAERATOR AIDS IN PRODUCTION OF SYNTHETIC "BEAD" CATALYST

At the Paulsboro plant there is produced a synthetic catalytic agent used in the refining of high test aviation gasoline. One of the ingredients is river water which has been demineralized but is still saturated with oxygen and contains up to 50 ppm of carbon dioxide. A Cochrane Cold Water Deaerator, operating at 35° F. and under vacuum, removes the dissolved oxygen and carbon dioxide at 1650 GPM.

Why go to all the trouble?

Sand-packing prevents flattening of the walls when piping is bent—and the results are easy to see.

But *you* can't see what happens to the metal in the bending process.

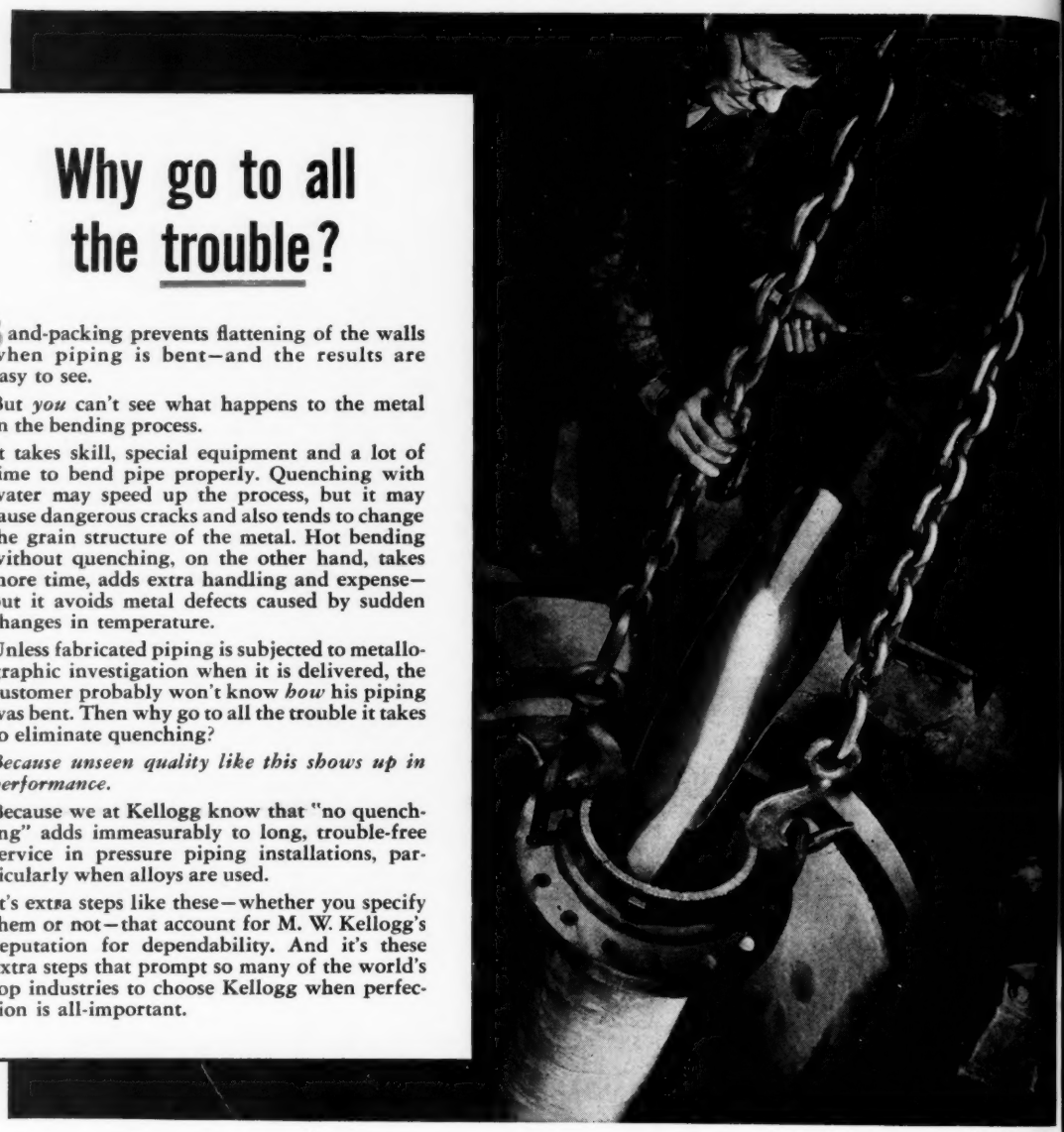
It takes skill, special equipment and a lot of time to bend pipe properly. Quenching with water may speed up the process, but it may cause dangerous cracks and also tends to change the grain structure of the metal. Hot bending without quenching, on the other hand, takes more time, adds extra handling and expense—but it avoids metal defects caused by sudden changes in temperature.

Unless fabricated piping is subjected to metallographic investigation when it is delivered, the customer probably won't know *how* his piping was bent. Then why go to all the trouble it takes to eliminate quenching?

Because unseen quality like this shows up in performance.

Because we at Kellogg know that "no quenching" adds immeasurably to long, trouble-free service in pressure piping installations, particularly when alloys are used.

It's extra steps like these—whether you specify them or not—that account for M. W. Kellogg's reputation for dependability. And it's these extra steps that prompt so many of the world's top industries to choose Kellogg when perfection is all-important.



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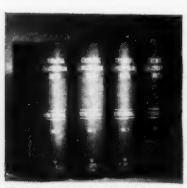
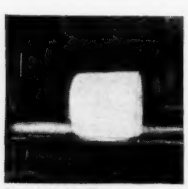


Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



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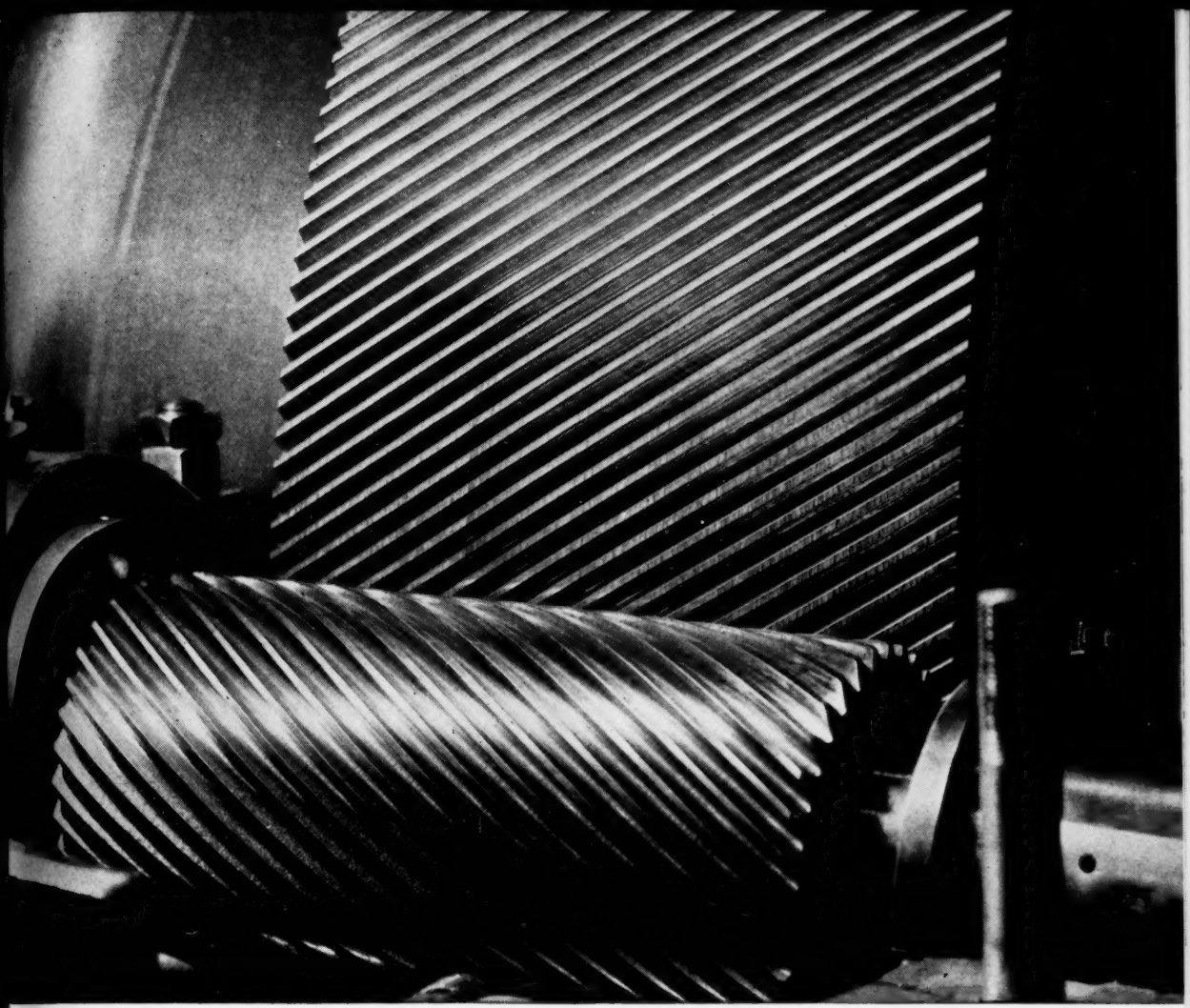


Turbine gears like new after 25,500 hours with

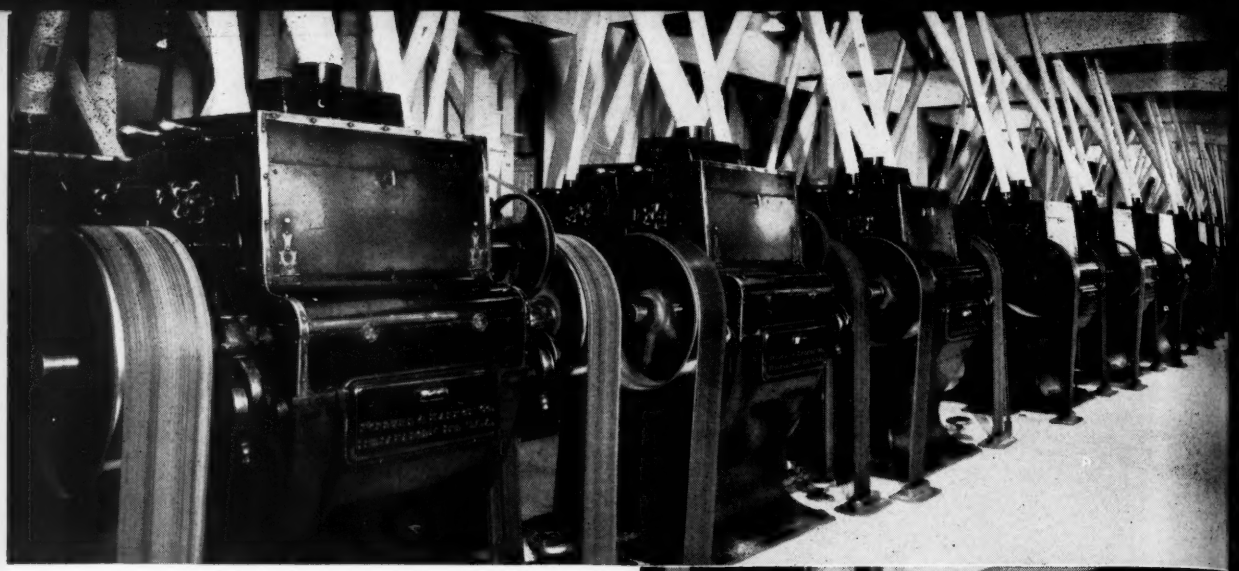
NONPAREIL
TURBINE OIL

TAKE a close look at this unretouched photograph of the gears in a 5000 KW geared turbine. It is hard to believe they aren't new. Yet they operated 25,500 hours during the war in an English paper mill. They were lubricated by the same oil that was used on the turbine bearings—Nonpareil Turbine Oil.

Not only was wear reduced to the minimum but the oil system was completely free from deposits. Oil acidity at no time exceeded the extremely low neutralization number of 0.07mgKOH/gm. The oil required neither treating nor sweetening.

Nonpareil assures protection against acidity, deposits and corrosion for gears, bearings, governors and turbine oil systems. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

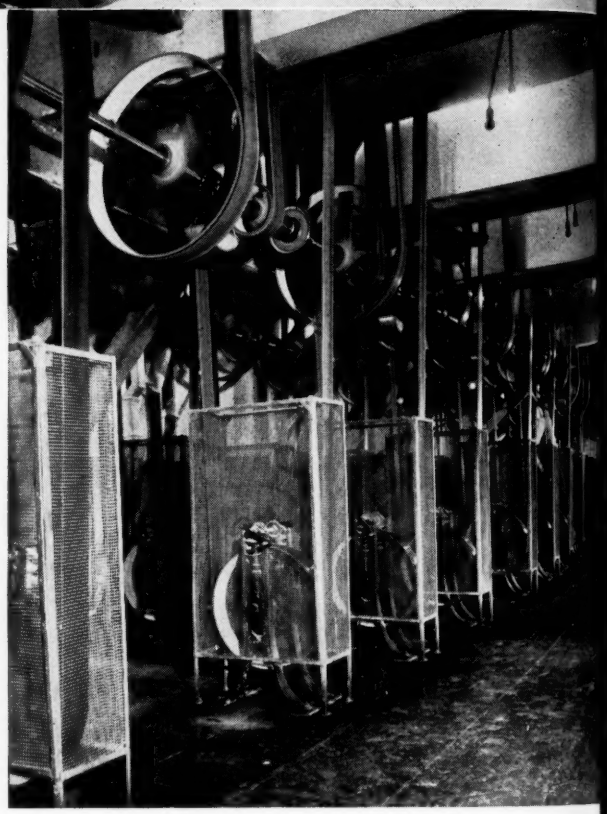


Cleaner operation...

cooler-running bearings...

lower power demand...with

Stanodrip



TESTS in a large midwest flour mill quickly proved the superior lubricating and dripless qualities of Stanodrip.

Oil leakage from ring-oiled bearings on the rolls and the line shafting had jeopardized clean operation. Overheating of roll bearings had lowered operating efficiency.

But Stanodrip stayed in the bearings, provided protective lubrication and reduced power demand for starting the mill.

Unusual stringiness and driplessness give this unique oil an adhesive quality that prevents oil throw-off or leakage. Instead of co ventional soap or rubber thickening ingredients, Stanodr contains a thickening component that resists oxidation an separation.

To test or discuss the possible advantages of Stanodrip i your plant, a Standard Oil Lubrication Engineer will be gla to call on you. Write Standard Oil Company (Indiana), 91 South Michigan Avenue, Chicago 80, Illinois.

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. . . but totally different at the crank shaft

Boiler feed and other high pressure services reach a new high in efficiency and a new low in cost when Worthington Triplex Power Pumps put the pressure on.

WHICH DO YOU NEED?

Whether you require the constant stroke of the VTE or the variable capacity of the Variflo, you get such efficiency-increasing, cost-lowering features as: totally enclosed power end; pressure lubrication on all bearings except the flood-lubricated main bearings; simple construction without reduction gears; patented flange and screw-type gland; full accessibility to plungers, valves and running parts. A complete range of sizes covers capacities up to 165 gpm in single units.

HOW VARIFLO DIFFERS

Worthington Variflo Triplex Power Pumps give you automatic, stepless capacity control from 0% to 100% at constant speed. The simple, rugged stroke-changing mechanism, carried in the crank shaft, is the only difference between Variflo and VTE.

Bulletins, describing how Worthington Triplex Power Pumps achieve dependable operation at minimum costs, prove that *there's more worth in Worthington*. Write for them to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.*

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The cost of a new Detroit RotoStoker is in your coal pile today. The savings that can be effected by this *more satisfactory* and *economical* firing method will pay for a RotoStoker. Buy your coal from the most convenient sources because the RotoStoker has a reputation for burning a wide range of fuel. Rapidly fluctuating loads are easily handled.

The Detroit RotoStoker is a spreader stoker with *Overthrow Rotors* that assure *dependable* and *uniform fuel distribution.* Built with stationary, hand dumping or power dumping grates.

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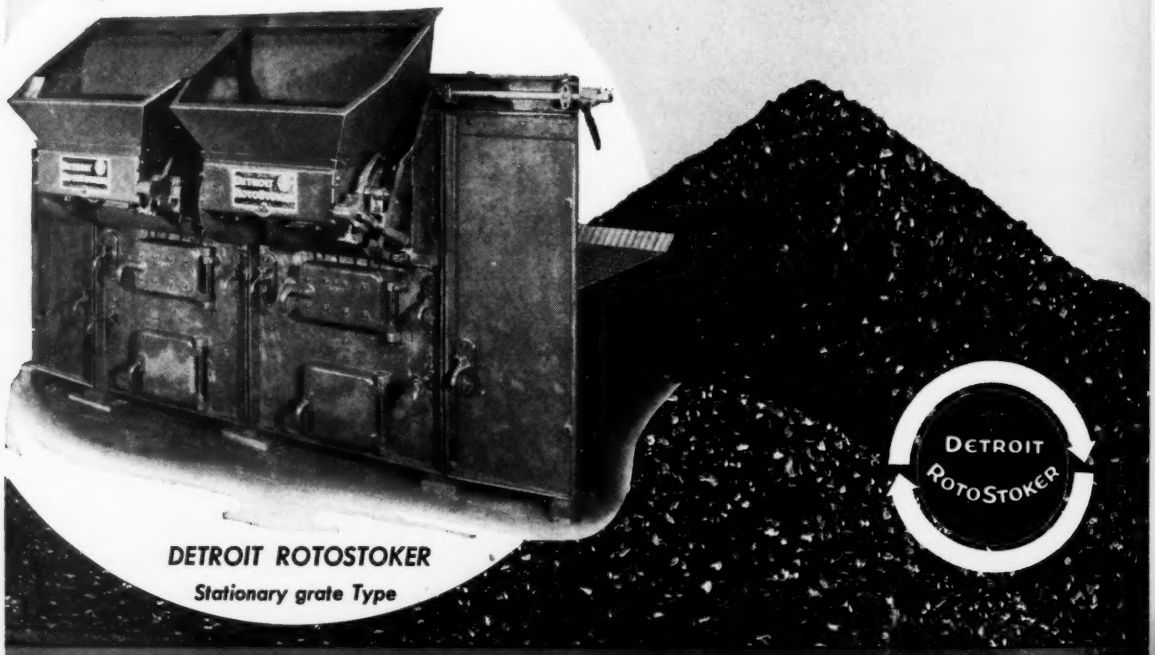

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Increase water well production—the chemical way!

The record speaks for itself. Treatment results in Dowell files list the many production increases which have been secured through the proper chemical treatment of water wells.

The chemical removal of retarding incrustations on screens, tubing and pump equipment and the enlargement of formation pores permit the production of more water—faster!

Dowell pioneered the well-acidizing field and its engineers have the know-how based on years of experience gained in treating thousands of oil, gas and water wells. Call the nearest Dowell office for a free estimate. Ask also about Dowell chemical scale removal service for water lines, steam generating and heat exchange equipment.

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Dowell's industrial engineers are selected for experience and ability—trained in the field and in the laboratory. Dowell's field equipment is scientifically designed to control, step-by-step, the complete scale removal process. Solvents are chosen and mixed to fit each individual job.

FREE SHOWING! *New 18-minute sound slide film illustrating the possibilities of Dowell Chemical Scale Removal Service. To arrange a special showing call or write Dowell.*

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FOR RECIPROCATING SERVICE

J-M Sea Rings are made to give years of service without replacement. They automatically seal on the work stroke, release on the return, reducing friction to a minimum. Use them on smooth rods ¾" O.D. up, in packing spaces 5/16" wide and up.

FOR CENTRIFUGAL SERVICE

J-M Centripac makes a tight seal with minimum friction. Plaited square, it forms a broad bearing surface on rotating and oscillating rods. Recommended for use on centrifugal pumps handling water, brine, ammonia, oil, gasoline, weak acids, chemicals.

FOR VALVE STEMS

J-M Mogul remains permanently soft and resilient . . . seals without binding . . . assures long, economical service on valve stems and reciprocating rods with small packing spaces. For water, oil, air, ammonia and similar fluids. For gummy fluids, use J-M Jewett.

FOR FLANGE SERVICE

J-M Service Sheet has long been industry's standard gasketing material for high pressure and temperature applications because it is uniform in composition, density, strength, thickness and resiliency. For special applications, J-M furnishes a variety of sheet packings made from 13 basic materials.

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JM PRODUCTS

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PACKINGS & GASKETS

RADIOACTIVE ISOTOPES AS TRACERS

(Continued from page 107)

daily checks on whether the plate had been properly washed simply by measuring the radioactivity which (literally) still clung to it. He was able to detect the radioactivity of the plate for many days. History does not explain whether this is to be ascribed to the carelessness of the landlady or to the extreme sensitivity of the method.

While Hevesy referred to his radioactive isotopes as "indicators" in recent years, English-speaking scientists more often use the terms tracers and tracer method. Robley Evans[4] also calls them "spies," since they go around unrecognized in the company of normal atoms of the same chemical type, and at a later time reveal the detailed movements of the normal atoms which they accompany. Ordinary experiments employ one spy atom for each 10 billion to 1000 billion normal atoms whose course is to be traced. Translated into terms of human society, this would be equivalent to one spy among a population at least five times as large as that of the entire world.

Methods of Detection

Before we describe specific applications of the tracer method in a following article, a few words on methods of detection will be of interest. The effectiveness of the tracer method as we have just seen depends upon the extreme sensitivity of the method. Various detectors, however, have different sensitivities and the particular type of detector employed depends upon the degree of radioactivity that may be present. Where relatively strong radioactive sources are available, a simple ionization chamber and electrometer, or an electroscope, are satisfactory for observing the integrated ionization produced by a large number of beta rays. Where only a few such rays (actually they are electrons) are present, an instrument of the highest sensitivity such as the Geiger-Müller counter must be used. Such an instrument will count the electrons one by one.

The Geiger-Müller counter involves the use of an electron tube amplifier which amplifies the pulse produced in the counter tube by the ionization of the electrons.

The Geiger-Müller counter, basically, consists of a cylindrical cathode and an axial fine wire anode, as shown in Fig. 4. These elements are carefully sealed into a glass envelope containing dry air or other gas at a pressure of about one-tenth of an atmosphere. When carefully regulated d-c potential is connected across the two electrodes, a voltage can be found at which no discharge takes place through the tube until a single free electron enters the space be-

[4] Dr. Robley D. Evans is associate professor of physics at Massachusetts Institute of Technology.

tween the anode and the cathode. When this occurs, a momentary electrical discharge takes place and immediately quenched. This discharge is amplified by the associated electron tube amplifier and the output voltage delivered to a suitable indicating, recording or integrating instrument. The output of such an amplifier consists of a series of pulses which are randomly spaced in time since the radioactive disintegration follows the usual statistical laws for a random process.

Various types of counters are employed. Where very high rates of counting are required, highest accuracy is obtained by feeding the series of randomly spaced pulses into a capacity-resistance tank circuit and observing the relatively steady current thus produced in the tank circuit resistance, which is the operating principle of the counting rate meter.

Recent developments in radio autographic method of detection

One method of detection, involves the use of a photographic emulsion. This is the well-known method of radio-autography in which a radioactive isotope is introduced into a biological or other system, and the distribution of that particular element within the system is determined by bringing the sample in close contact with a photographic emulsion. As it has been used, this method lacks resolving power, because, even in the case of perfect contact of the sample with the emulsion, the circle of confusion from every point of emission is so great that details less than a tenth of a millimeter are different or impossible to distinguish.

Because of this shortcoming, an improved procedure has been effected recently by L. Marton of the National Bureau of Standards with the co-operation of P. H. Abelson of the Dept. of Terrestrial Magnetism, Carnegie Institution of Washington. In this procedure, by means of a magnetic focusing arrangement, the radiation given off by a radioactive isotope within a sample material is made to form an image of the emitting surface upon a photographic plate. The principle involved is similar to that of the electron microscope.

In the absence of any means for correction of the chromatic aberration of electron optical lenses, the first attempts in this development were limited to the use of isotopes which emit electrons (beta rays) of uniform speed. After several preliminary attempts, gallium 67 was selected for the initial tests. Gallium chloride, prepared by chemical separation from zinc, was bombarded by heavy hydrogen nuclei in the cyclotron at the Carnegie Institution, and the solution was evaporated, drop after drop, on a ¼ in. tantalum disk. Radiation emitted from the surface of the disk, upon passing through the

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Located conveniently near you is a distributor who maintains a wide and varied stock of Johns-Manville Packings.

He is one of more than 400 authorized Johns-Manville Packing Distributors located in principal industrial areas, who have been selected for reliability, quick service and fair dealing. He knows packing and understands its applications. He can supply special as well as conventional needs promptly.

In addition to Johns-Manville Packings in many forms and sizes, your J-M Distributor carries many other industrial supplies. You can always depend upon him for good service and a square deal.

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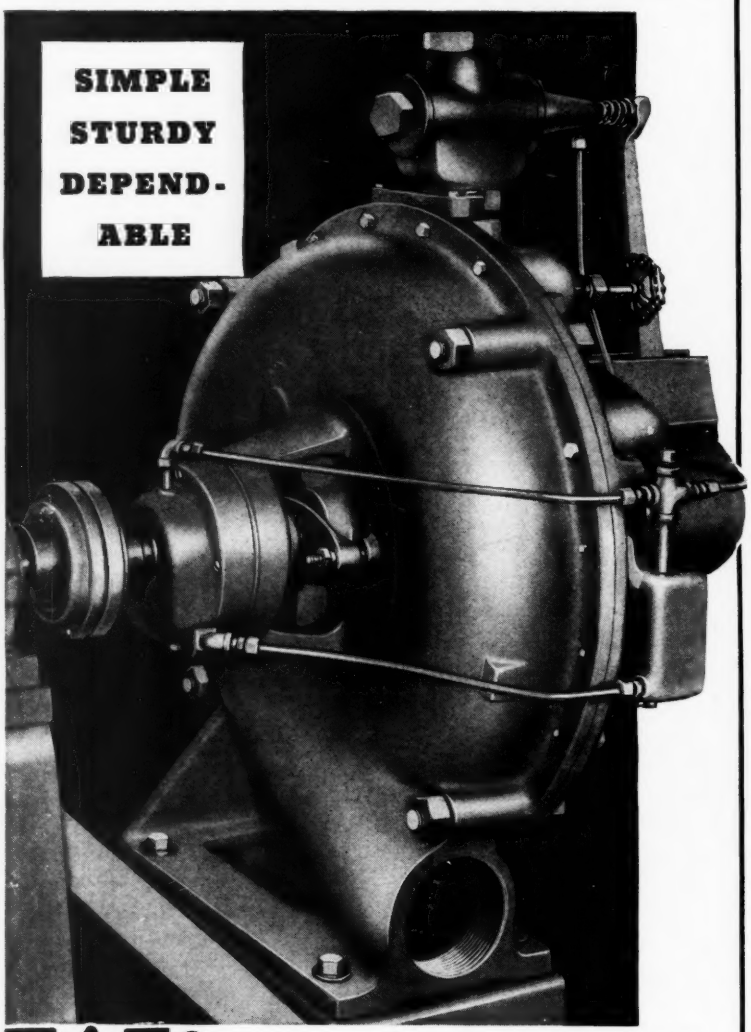

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FEATURES:
CAPACITIES—up to 150 h.p.
SPEEDS—up to 4,000 r.p.m.
Capable of Exhausting against HIGH BACK PRESSURES
SHAFTS—Horizontal or vertical
ROTATION—Clockwise or counter-clockwise

LUBRICATION—Wing Filtered Oil Lubricating System or Grease
GOVERNOR—Overspeed trip and Speed Regulating
OIL-FREE EXHAUST STEAM may be used for heating or process work.

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REVOLVING UNIT HEATERS • UTILITY HEATERS • FIXED DISCHARGE UNIT HEATERS
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magnetic lens (Fig. 6) was brought to a focus on a photographic film at a distance of 3½ in. An image of the tantalum disk was thus obtained showing radioactive areas. The conditions were selected so that a linear magnification of 2 was produced.

For calibration of the instrument, which is shown in Fig. 5, the photographic film was replaced by a Geiger-Müller counter, and the lens current necessary to produce a maximum number of counts in unit time was determined for radiations of varying velocities. In the preliminary experiments with samples of different concentrations and thickness of the radioactive layer, exposure times ranged from 2 to 12 hr, according to the age and concentration of the sample and the numerical aperture of the lens.

This new device has been described in some detail because it is indicative of the type of development that is proceeding on all fronts in nuclear physics. In this case, the idea was borrowed from the electron microscope. All knowledge becomes useful—one development helps another.

In a second article, we shall discuss more specifically the application of the tracer method to various purposes.

COMING EVENTS

ASME—Fuels Division Meeting of the American Society of Mechanical Engineers; to be held October 6 through 8, in Houston, Texas. (Headquarters not yet announced.)

Hydraulics—Third Annual Meeting of the National Conference on Industrial Hydraulics (formerly the Hydraulic Machinery Conference); to be held October 16 and 17 in Chicago with headquarters at the Hotel Continental.

ASM—The 29th Annual National Metal Congress and Exposition; to be held in Chicago's International Amphitheatre for seven days beginning Saturday, October 18, 1947.

Industrial Management — Midwestern Conference on Industrial Management; to be held at the University of Missouri, October 23 through 25.

Prime Movers — Fall Meeting of the Prime Movers Committee of the Pennsylvania Electric Association is scheduled for October 23 and 24, 1947, in the Benjamin Franklin Hotel, Philadelphia, Pa.

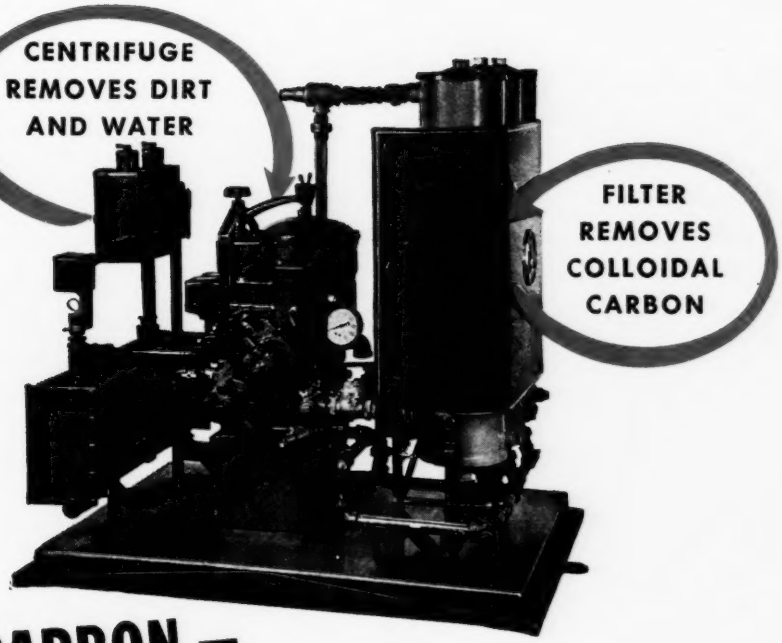
Water Conference—The 8th Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in the William Penn Hotel, Pittsburgh, Pa., on November 12, 13, and 14.

Notice—Midwest Engineering and Power Exposition originally scheduled for November 15 through 20 has been cancelled.

ASME—Annual Meeting of the American Society of Mechanical Engineers; to be held in either New York City or Atlantic City, N. J., December 2 through 5. Headquarters Chalfonte-Haddon Hall.

SESA—The annual meeting of the Society for Experimental Stress Analysis; to be held December 4, 5 and 6 at the Hotel Pennsylvania, New York City.

Refriegration and Air Conditioning Exposition — Fifth All-Industry Exposition; to be held January 26 through 29, 1948, with headquaretrs at Cleveland Public Auditorium, Cleveland, Ohio.



FOR OIL THAT'S CLEAN AND FREE OF COLLOIDAL CARBON—

The De Laval "Puri-Filter"

THE DE LAVAL "Puri-Filter" enables every Diesel operator to get a higher degree of purity in cleaning his Diesel lubricating oil than ever before. The De Laval "Puri-Filter" is a combination of a De Laval "Uni-Matic" Oil Purifier and two or more Fram "Filcron" Filters. The "Uni-Matic" rids the oil of dirt and water, and the filters take out the colloidal carbon.

The De Laval "Puri-Filter" restores lubricating oil to a condition closely resembling new oil. It keeps the oil so clean, in fact, that crank case inspection, once one of the messiest jobs in power house routine, can usually be done without even soiling jumpers. This statement is vouched for by actual experience.

Bulletin DL-1 gives additional details on the De Laval "Puri-Filter". Write for your copy.

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WITH TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT

That's why Darts have been leaders in unions for over 50 years. Their sound construction stands up indefinitely. Their non-corroding bronze-to-bronze seats are precision-ground to form a drop-tight connection. They close and open easily without jamming or excessive wrenching . . . and they're least expensive in the long run. Body and nut are of high-test, air-refined malleable iron — practically indestructible.

Your supplier will gladly demonstrate their points of superiority.

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Obituaries

BOYD C. DENNISON

BOYD COE DENNISON, 66, professor of electrical engineering at the Carnegie Institute of Technology, died recently in his home at Pittsburgh, Pa.

Mr. Dennison, who was born in Hannibal, N. Y., was graduated from Cornell University in 1904 and received a Master of Electrical Engineering degree from that university in 1908. A member of the Carnegie faculty for 37 years, he was made a full professor in 1929.

Before coming to Carnegie, Mr. Dennison taught at Cornell and was associated with the testing department of the General Electric Co. in Schenectady, N. Y. During his long career on the Tech faculty he was active on many student and faculty committees.

The co-author of "Electrical Problems," Mr. Dennison was also the author of several articles on electrical engineering in such publications as the Southern Electrician, Electrical World, and the Sibley Journal.

He was a member of Sigma Xi, Tau Beta Pi, Eta Kappa Nu, Alpha Phi Omega and Phi Kappa Psi. Chairman of the Pittsburgh section of the American Institute of Electrical Engineers in 1921, Mr. Dennison was also a member and elder of the East End Christian Church.

He is survived by his wife, Ada Pease Dennison; two sons, Boyd C., Jr., and Richard W., and a sister, Mrs. Ella D. Wilder of Riverview, N. J.

JOSEPH E. SIRRINE

JOSEPH EMORY SIRRINE, engineer and founder of J. E. Sirrine & Co., died recently at the age of 75. The company which Mr. Sirrine founded will continue in business under the name of J. E. Sirrine Co.

NEWS *from* THE FIELD

GERMAN SYNTHETIC FUELS EQUIP. GOES TO LOUISIANA, MO.

SEVERAL PIECES of massive German industrial equipment, employed during the war in the production of synthetic liquid fuels for the Nazi air and ground forces, have been brought to this country for examination by the Bureau of Mines, according to Thos. H. Miller, acting bureau director. This equipment and sample lots of German-made catalytic materials have been consigned to the Missouri Ordnance Works near Louisiana, Mo., which now is being converted by the bureau to a synthetic fuels demonstration plant for obtaining oil and gasoline from coal.

The shipment included a giant hydrogenation-process converter weighing 130 tons, 60 ft long and cylindrical in form, with a maximum diameter of 7 ft.

Other bulky equipment to be examined in detail and used as a guide in preparing American designs includes a 10 by 18 ft gas synthesis process converter and a 4 by 60 ft "wickel-ofen" type heat exchanger, each weighing 60 tons; two 6 by 30 ft coal paste injectors weighing 30 tons each, and a 3 by 50 ft hairpin bend from a paste preheater weighing 7 tons.

A Linde-Frankl oxygen plant unit, with a capacity of 25,000 cu ft of oxygen per hour, also has been received and will be reassembled at Louisiana, Mo., for use in the bureau's synthetic fuels experiments.

Remember this Fan . . .

You don't have to baby the new Moore fans and blowers. Rugged and corrosion-resistant, you can install them and forget them. Read why!

The Moore Company of Kansas City, Mo., realized that pressure fan users were getting fed up with breakdowns and time-consuming servicing of their air-moving equipment.

So, this company decided to design a blower . . . from start to finish . . . that would give extra-long life and trouble-free performance.

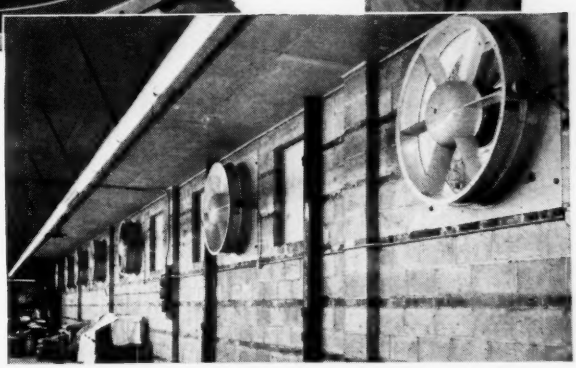
In the hub of their new unit, they built a heavy-duty, direct-drive motor. This has only one moving part . . . the rotor to which the fan is attached.

The entire motor assembly is isolated by soft synthetic rubber mounts. Bearings are permanently lubricated and sealed.

But, that's not all. Moore engineers also realized that corrosion figured heavily in fan failures. Blades, guide vanes, hubs, and rims must withstand damp or steamy atmospheres, smoke, coal dust . . . or even acid fumes.

The one metal Moore found to lick all these conditions was the INCO *Nickel Alloy . . . MONEL**.

In addition to its corrosion resistance, Monel also fights abrasion. And, it's as strong as structural steel. Thus, the curved and formed fan sections are thinner and far lighter than cast parts . . . without sacrificing strength.



Moore direct-drive ventilating fans and pressure blowers are available from 36" to 96" in diameter, with capacities up to 125,000 cu. ft. per minute. Other Moore fans range up to 24 ft. in diameter, capacities of more than 1,000,000 C.F.M. Made of tough, corrosion-resistant Monel, they are used today by power stations, foundries, oil refineries, textile mills, and many other industrial plants. For detailed information, address The Moore Company, 544 Westport Road, Kansas City 2, Missouri.

* * * *

The above is another example of how strong, long-lasting INCO Nickel Alloys are serving modern power plants. Other applications include preheater tubing, valves, pump parts, fittings, and gaskets.

If *you* are looking for one metal to solve a tough combination of problems, find out more about the family of INCO Nickel Alloys. Full technical information and assistance are yours for the asking.

*Reg. U. S. Pat. Off.

The International Nickel Company, Inc.

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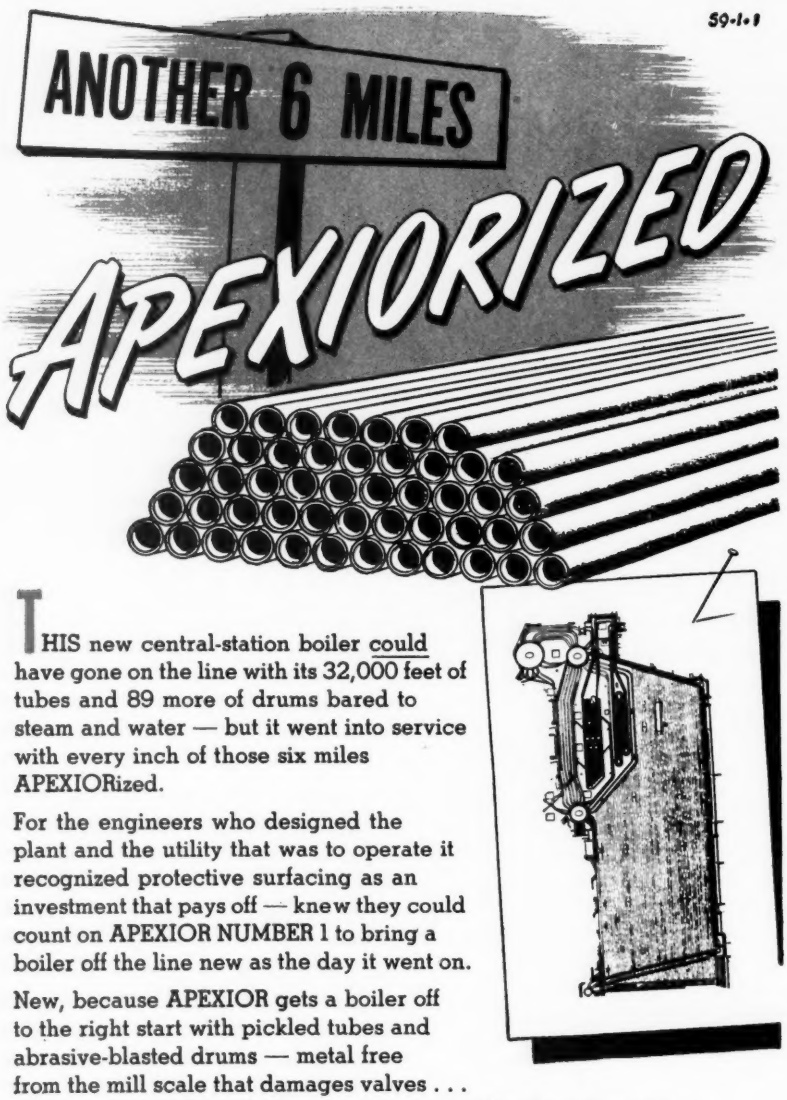
EMBLEM OF SERVICE
INCO
TRADE MARK



THIS new central-station boiler could have gone on the line with its 32,000 feet of tubes and 89 more of drums bared to steam and water — but it went into service with every inch of those six miles APEXIORized.

For the engineers who designed the plant and the utility that was to operate it recognized protective surfacing as an investment that pays off — knew they could count on APEXIOR NUMBER 1 to bring a boiler off the line new as the day it went on.

New, because APEXIOR gets a boiler off to the right start with pickled tubes and abrasive-blasted drums — metal free from the mill scale that damages valves . . . causes pitting, electrolytic corrosion, or localized overheating — clean surfaces that are an assurance of quality.

APEXIOR maintains that quality throughout the life of the boiler, for it never gives corrosion a start — never allows water or steam to penetrate to the steel beneath — and because it smooths as it seals, repels deposits — never lets them gain a foothold.

That's why APEXIORized metal is an investment in better heat transfer — longer in-service time — less costly cleaning . . . why it can mean so much to your new boiler, or one already on the line.

WRITE US FOR MORE FACTS ABOUT

DAMPNEY *Maintenance for Metal*

The DAMPNEY COMPANY of AMERICA, Hyde Park, Boston 36, Mass.

Other equipment received included a DeLaval centrifuge and special purpose valves, fittings, lens gaskets, and instruments.

Some 580 drums containing various types of hydrogenation-process catalysts and several additional drums of vapor-phase hydrogenation catalyst were obtained to determine the merits of the German-made catalysts in processing American coals.

SAFE USE OF LIQUEFIED GAS

THE ASSOCIATION of Casualty and Surety Companies has just issued a booklet titled "Safe Use of Liquefied Petroleum Gas in Industry." The booklet covers safe practice in transportation, liquid storage, vaporizing, combustion systems, piping systems, utilization and accident and fire prevention. Single copies are available from the Association at 60 John St., New York City. In quantity, the booklets may be had at $7.00 per hundred.

BOGAN BUSINESS ASSISTANT OF BCR

ANNOUNCEMENT has been made of the appointment of Joseph A. Bogan as business assistant on the staff of Bituminous Coal Research, Inc., a position recently authorized by the executive committee of the BCR Board of Directors.

Mr. Bogan, who came to the national research agency from Carnegie-Illinois Steel Corp., will handle contractual, patent and similar transactions of a business nature involving BCR, allied industries, manufacturers, and laboratories in which research projects are placed. He will work closely with Dr. Harold J. Rose, vice president and director of research, and his assistant, Elmer R. Kaiser, to expedite business matters.

ADVISORY COMMITTEE FOR CHEMICAL EXPOSITION

AN ADVISORY committee composed of eminent consulting chemists, chemical engineers, heads of professional societies, leading industrialists and editors has just been announced for the 21st Chemical Industries Exposition which will be held in Grand Central Palace, New York, Dec. 1 to 6.

Plans for the exposition are progressing at a rate which indicates that every inch of space available for exhibition purposes on four floors of the Palace will be occupied with displays of extraordinary interest.

General arrangements and management of the exposition are in the hands of the International Exposition Co. with permanent headquarters in Grand Central Palace.

BUXTON HEADS PIPE RESEARCH

E. A. BUXTON has been elected chairman of the Committee on Steel Pipe Research of the American Iron and Steel Institute. He succeeds E. P. Corey, who has retired after 52 years in the steel pipe industry. Mr. Corey served as chairman of the committee from its inception in 1942.

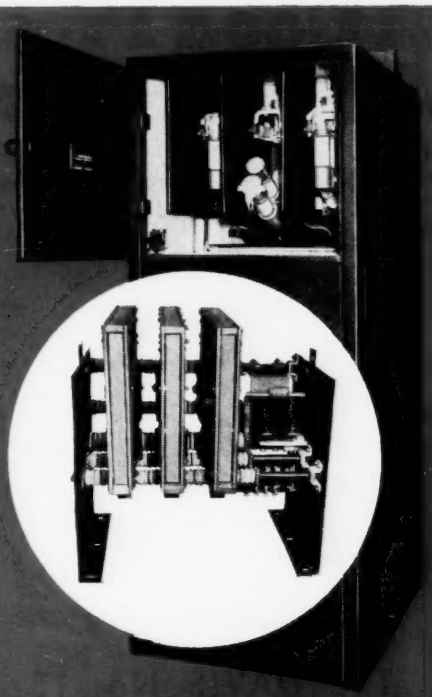
Mr. Corey has been general manager of tubular sales for the Youngstown Sheet and Tube Co. Mr. Buxton is sales manager, Pipe and Tubes, for the Bethlehem Steel Company. Oscar I. Strickland, manager of Tubular Sales for the Wheeling Steel Corporation, was elected vice chairman of the committee.

The Committee on Steel Pipe Research of the American Iron and Steel Institute was established in 1942, to handle exclusively matters concerning steel pipe and to collaborate with the Subcommittee on Pipe of the Committee on Building Codes of the Institute.

Sound technical and factual data and practical information prepared by the committee are of value to users of pipe, architects, engineers and salesmen. In addition to the research by individual pipe manufacturers which will be continued, there are many phases which can be handled

Motors are hard to get...

Guard them with LIMITAMP CONTROL



Limitamp control is furnished as a single unit, in groups, or in special enclosures for special operating conditions.

Limitamp control can provide those hard-to-get motors with sure, short-circuit protection. In less than *one-quarter* cycle, Limitamp's EJ-2 fuses cut off a rise in current from a short, and clear it in one-half cycle—long before the short has time to harm the contactor or motor. Your plant's power system needs this prompt handling of fault currents, and you will avoid the risk of costly shutdowns that can result from just *one, mad short circuit.*

A STARTER AND PROTECTOR IN ONE CABINET

G-E Limitamp control consists of an airbreak contactor (the motor starter), and EJ-2 fuses (the short-circuit device). They are mounted in separate compartments of one, all-steel cabinet.

Airbreak contactors are specially designed for hard duty. Operating experience has proved they furnish long-lived, low-cost service with only routine maintenance.

Because they operate in air, they eliminate the problem of handling oil. And tip life of airbreak contactors is many times that of comparable oil-immersed tips.

You can depend on EJ-2 fuses for sure, short-circuit protection. They are "fail-safe" devices. There is nothing about them to wear. They are easy to replace.

OVERLOAD AND UNDERVOLTAGE PROTECTION

Isothermic overload relays, accurately calibrated against actual motor characteristics, guard the motor against overheating from sustained loads or single phasing.

FACTORY-ASSEMBLED CONTROL

Factory-assembled in one cabinet, Limitamp is easy to install, easy to co-ordinate with other control, saves space, and improves the appearance of your plant.

The Trend is to **AIR**

G-E LIMITAMP . . . THE FIRST HIGH-VOLTAGE CONTROLLER WITH AIRBREAK CONTACTORS

MAIL THIS COUPON!

Apparatus Department,
General Electric Company, Section J676-251
Schenectady 5, New York

Please send me Bulletin GEA-4247 on Limitamp control.

Name.....

Company.....

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DEPARTMENT OF TECHNOLOGY
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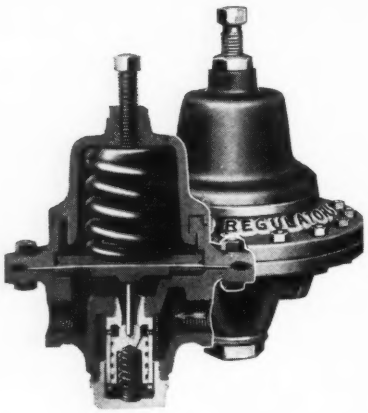
GENERAL ELECTRIC

XUM

A Good Pressure Regulator for Small Units

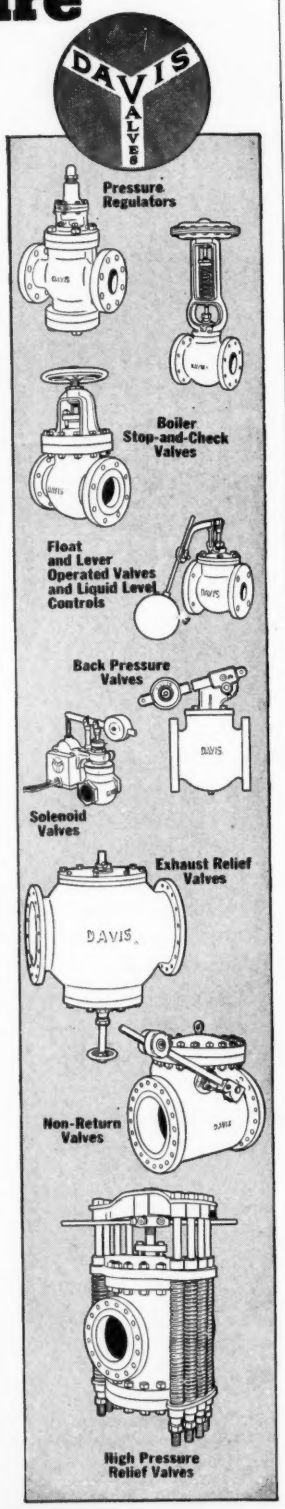


The DAVIS No. 13 Regulator

• Where a restricted flow of steam, air, or gas at reduced pressure is desired, the Davis automatic pressure reducing valve is the ideal answer for many requirements. It is a quality pressure regulator built to give accurate, trouble-free service—yet priced low enough for use on small steam heated units such as unit heaters, presses, jacketed kettles, sterilizers, and vulcanizers as well as on all types of air-operated equipment. No. 13 features: built-in strainer, single seat, tight-closing valve, venturi type port and completely enclosed construction. All parts are accessible and renewable without disturbing pipe connections. Pressure reduction maintained regardless of circulation. Available in semi-steel, bronze, or steel body with bronze monel or nitralloy trim. Sizes ⅜" to 2". For any pressure up to 400 p.s.i. and for reduced pressure from 1 to 100 p.s.i.

The Davis Line of Pressure Regulators Is Complete!

• 18 different types to choose from; standard sizes up to 24" and for pressures up to 500 p.s.i. Davis recommendations are not biased by any favored types. As the job dictates, you are free to choose between direct or piloted control . . . spring or weight loading . . . piston or diaphragm action. You have your choice of the degree of the sensitivity needed for the job—you don't have to pay for more than you need. Ask for a copy of Davis Bulletin No. 100A. For recommendations, send complete information on your job.



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appropriately by the steel pipe industry as a whole.

RESEARCH ON GAS BEHAVIOR

RESEARCH to aid in organizing data on the standard properties of gases and gas mixtures is being sponsored as a project of the Engineering Foundation, Dr. A. B. Kinzel, chairman of the board, said recently. Experimental studies and computations are being made at the thermodynamics research laboratory of the University of Pennsylvania, Philadelphia, under the direction of Dr. John A. Goff of The American Society of Mechanical Engineers.

"There has long been a recognized need for the organization of knowledge about the properties of gases over the widest practicable ranges of temperature and pressure," Dr. Kinzel stated. "This applies to a large number of technically important gases and gas mixtures.

"It is believed that the thermodynamic properties of gases can be calculated with high accuracy and thermodynamic consistency by the use of recent developments in recording mechanical theory."

The first phase of the research program calls for a systematic recalculation of zero-pressure properties from the best available spectroscopic data. Such data are given at too wide intervals of temperature to make corrections feasible by any other method.

WELDING LIBRARY CLASSIFICATION

A CLASSIFICATION system for the more than 11,000 welding patents now in the Davis welding library at Ohio State University is being established this summer, according to Dean Charles E. MacQuigg of the college of engineering.

In charge of the project, which will enable industries, students and research workers to obtain more readily information on all patents granted in their specific lines, is Dr. H. W. Simon of the University of Toronto.

Cost of the work is being paid from the A. F. Davis Welding Engineering Scholarship and Library Fund. Mr. Davis, vice president of the Lincoln Electric Co., Cleveland, and an alumnus of Ohio State University, established the welding library a number of years ago and at the same time set up such a scholarship fund.

CYCLONE BURNER FOR FISK

WHEN the recently ordered 150,000-kw turbo-generator goes into service in 1949 at Commonwealth Edison Co.'s Fisk station, Chicago, it will be driven by steam produced with the revolutionary new type of unit known as the cyclone burner, Charles Y. Freeman, chairman of the utility, has announced.

Developed through years of cooperative research by Babcock & Wilcox, the engineering firm of Sargent & Lundy, and Commonwealth Edison Co., the extremely efficient and compact equipment gets its name from the cyclonic manner in which coal is blown and circulated inside the burning chamber. It supplants the burning of coal on a chain grate or in pulverized form. An experimental furnace, installed in 1943 at Edison's Calumet station, has performed so well the utility has decided to make the new units standard on newly ordered additions to its generating capacity.

The cyclone furnace is designed to burn coal such as is mined in central Illinois, the company's chief source of supply.

AWS ANNOUNCES PROGRAM

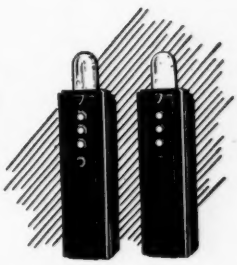
THE AMERICAN WELDING SOCIETY has completed the tentative program for its twenty-eighth annual meeting to be held October 19-24 at the Hotel Sherman, Chicago, Ill., during the National Metal Ex-

THE HIGH COST OF BACK-PRESSURE: $21000/year

Just exactly how high the cost of back-pressure really is was recently proved in a Southern power station. Slime-fouling on condenser water side surfaces accumulated between plug cleanings to build back-pressure up from approximately 0.6" to a maximum of 1.1". That extra back-pressure on a 30000 KW base load unit *boosted* steam consumption an average of 7500 pounds per hour. At a cost of about $0.34 per thousand pounds and with the turbine operating 24 hours per day 350 days per year, the cost of back-pressure figures out to be $21000 per year.

THE LOW COST OF CORRECTION: $5000/year

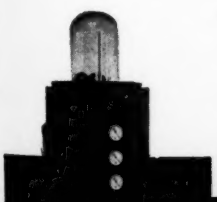
Chlorination applied through the W & T De-Sliming Process, at a total annual cost of approximately $5000 including amortization and all operating expenses kept the condensers slime-free, eliminated the need for plug cleaning and reduced equipment outage time.



NET $AVINGS: $16000/year

Not only did chlorination make operations easier and more effective, but the annual savings in steam alone amounted to $16000 — enough to pay for the investment in less than two years.

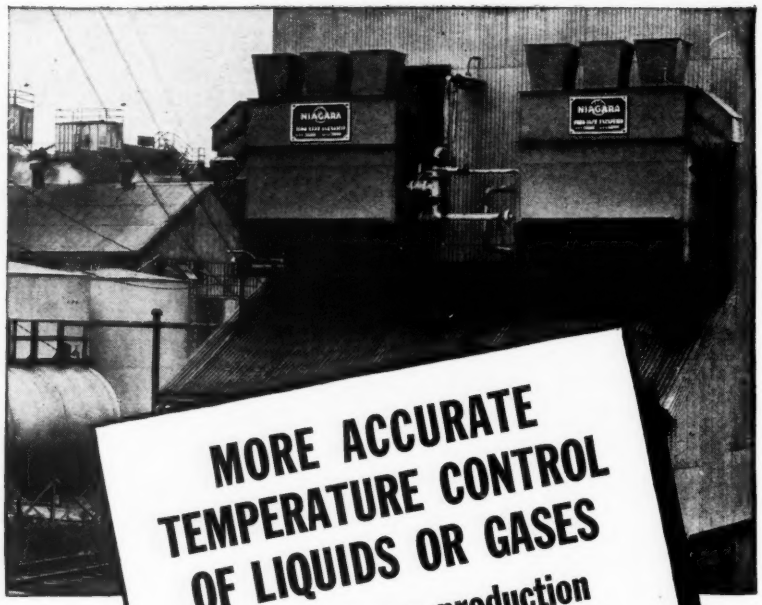
Your W&T Representative will be glad to make a study for you—without obligation, of course—to see if you, too, are paying the high cost of back-pressure.



CD-26

WALLACE & TIERNAN
PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus
Belleville 9, New Jersey • Represented in Principal Cities



● The Niagara Aero Heat Exchanger is used as a liquid or gas cooler in many industrial processes such as cooling jacket water for engines or process equipment; cooling lubricants, cutting oils, quenching baths, electronic sets, transformers, controlled atmospheric processes; condensing of steam, vapor, acid gases; compressed air or gas cooling.

Compared to conventional methods, it saves the cost of over 95% of the cooling water and its attendant piping and pumping. Its extra advantage, closer control of temperatures, has been found vastly more important in improving the efficiency of operation, increasing production and reducing maintenance troubles and expense.

Write for further information and examples in specific processes. Ask for Bulletin 96-PP.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

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Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

position. A total of 70 papers covering 16 classifications of welding applications and research will be presented at the twenty technical sessions during the week.

Highlighting the meeting will be President L. W. Delhi's reception on Sunday evening, October 19; the Adams Lecture by G. S. Mikhalapov, manager, Apparatus Research, Air Reduction Sales Co., and the awards of prizes and medals on Monday evening, October 20; the University Research Conference, Tuesday evening, October 21; the Section Conference, on Wednesday evening, October 22; and the annual banquet on Thursday evening, October 23.

LE CLAIR HEADS WASHINGTON AWARD

TITUS G. LECLAIR, chief staff engineer Commonwealth Edison Co., and past president of the Western Society of Engineers, has been elected chairman of the Washington Award Commission for the year 1947-1948.

The commission is charged with the duty of selecting the engineer whose professional attainments have pre-eminently advanced the welfare of mankind.

This award is for benefits of humanity, and there are no limitations as to education, membership in any society or organization, or circumstances of employment or official position.

The presentation of this award is made by the Western Society of Engineers at a joint meeting of the members of five participating societies. The American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers and the Western Society of Engineers.

The first presentation of the award was made in 1919 to an engineer, Honorable Herbert C. Hoover, and the last recipient in 1947 was Dr. Karl T. Compton.

STEGER EXECUTIVE SECRETARY WSE

DONALD V. STEGER, formerly director of industrial relations of the John B. Stetson Co., Philadelphia, was elected executive secretary of the Western Society of Engineers, effective August 1, William V. Kahler, president of the Society, announced recently. He succeeds Leigh S. Keith, who has been secretary of the Society since 1935. Mr. Steger is a native Chicagoan and a graduate of Loyola University, College of Law.

REFRIGERATION, A. C. SHOW

SIX MONTHS before the 5th All-Industry Refrigeration and Air Conditioning Exposition in Cleveland, January 26-29, it has been announced that the assignment of just 14 more exhibit spaces will assure a show the size of last year's, which covered 75,000 sq ft and four exhibition halls.

A total of 152 companies and associations already have taken 203 spaces, according to the Refrigeration Equipment Manufacturers Association, sole sponsors of the 1948 all-industry exposition. The fourth show, in October, 1946, was proclaimed the greatest in the industry's history, and Cleveland Auditorium officials agreed it was one of the greatest shows held by any industry.

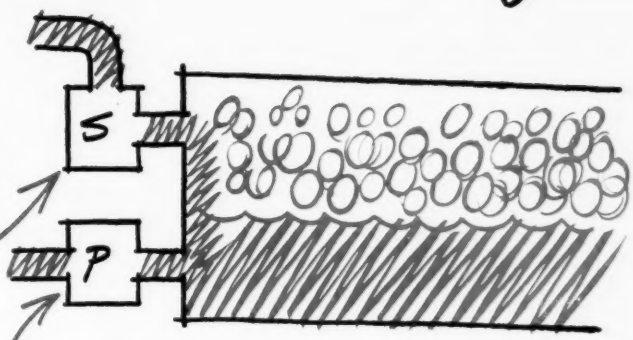
$5,000,000,000 ELECTRIC POWER CONSTRUCTION

FIVE BILLION dollars will be spent by electric light and power companies in the United States on construction within the next five years, Charles E. Oakes, president of the Edison Electric Institute, said August 4 in announcing the publication of the industry's Statistical Bulletin covering operations of the year 1946. Construction volume by the New York City electric power companies has already accelerated to the rate of a billion dollars a year, and this rate is expected to be maintained throughout this year and during the following four years, Mr. Oakes said.

LUBE MEMO

Air bubbles can wreck bearings

In our dry-sump system, air sucked through scavenging pump makes lube foam.



When foam gets into pressure pump, it loses suction, pumps insufficient oil to bearings...!!

Rep. says RPM DELO Diesel Engine Lubricating Oil stops foaming—How?

1. Special compounds in RPM DELO Oil minimize bubbles.
2. Lab. tests prove bubbles that form break up immediately

Phone RPM Delo Oil Rep.

DIESEL ENGINE RPM DELO LUBRICATING OIL

STANDARD OF CALIFORNIA • San Francisco, Calif.
THE CALIFORNIA COMPANY • Denver, Colo.
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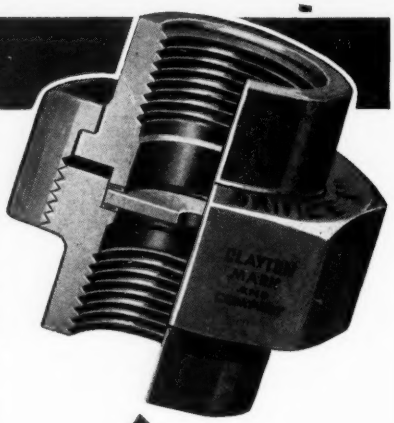
ORIFICE
FORGED STEEL UNIONS

Orifice

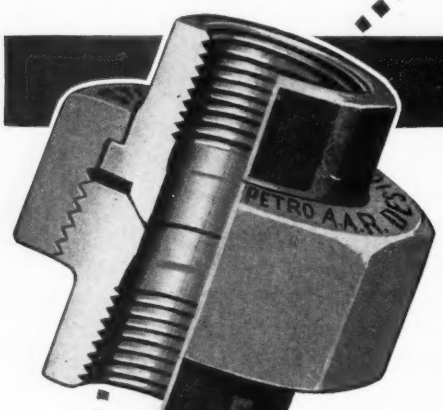


A SIMPLE, EASY-TO-HANDLE, MODERATELY PRICED, ORIFICE UNION.

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas and Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.

SIZES ¼" TO 3"

Petro



SIZES ⅛" TO 3"

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

CLAYTON MARK & COMPANY
1900 DEMPSTER STREET • EVANSTON, ILLINOIS

PHIL STEELE RETIRES FROM SPRINGFIELD PUMPING STATION

PHILIP STEELE, Chief Operating Engineer, Springfield Pumping Station, City of Chicago, retired August 31, 1947, after 32 years as an engineer in the service of Chicago.

Mr. Steele was born in Johnson, Vermont, June 19, 1865. His higher education includes a B.S. in mechanical engineering from the University of Illinois, class of 1889. He married Harriett Morrison, daughter of Dr. J. E. Morrison of Urbana, Ill., in 1891. Mrs. Steele died in 1945. Their only child, a daughter, died in 1910.

Philip Steele started with the City of Chicago as night engineer at the Hyde Park police station in 1895. Then followed positions of increasing responsibility: assistant engineer at the Fullerton Avenue pumping station, assistant chief operating engineer at 22nd Street pumping station in 1897, chief operating engineer of the Springfield pumping station, from which position he retired August 31.

He is past president of the Municipal Employes Society, past president of Local 556, International Union of Operating Engineers and chairman of the board, a member of Blaney Lodge, A. F. & M., 32nd degree, Shrine and Consistory. He will continue to live at 411 Fullerton Pkwy.

F. P. Zimmerli, Detroit metallurgical engineer, has been elected to receive the highest award for technical achievement conferred by the American Society for Metals. Announcement of the decision was made from headquarters of the Society at Cleveland. The honor, known as the Albert Sauveur Award, was first given by ASM in 1934 to perpetuate the memory of Dr. Albert Sauveur, world renowned professor of Harvard University.

The Research & Development Division of Pittsburgh Consolidation Coal Co., currently engaged primarily in the program of coal gasification, announced today the appointment of Dr. D. Leigh Fowler, Jr., 37, recently of Corning, N. Y., as manager of its Patent Department.

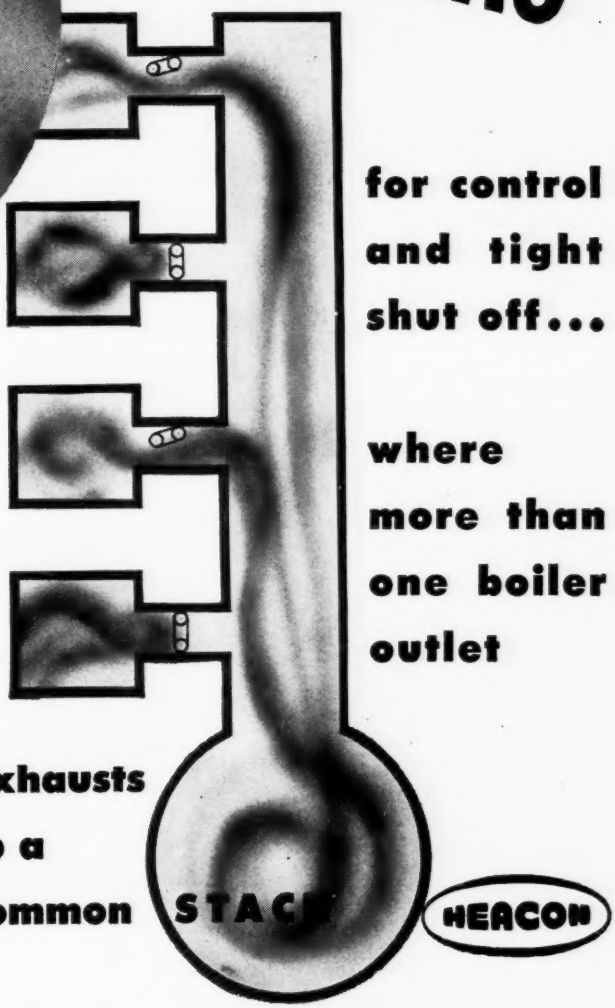
The consolidation of two divisions of the National Bureau of Standards—Commercial Standards and Simplified Practice—into a single division called Commodity Standards has been announced by Dr. E. U. Condon, Director of the Bureau. The new Commodity Standards Division will continue the Bureau's coordinating role in the development of voluntary simplified practice recommendations and commercial standards with industrial and technical groups. In addition, the division will be responsible for coordinating Bureau work for the Federal Specifications Board. Edwin W. Ely, former chief of the Simplified Practice Divisions, has been appointed as chief of the division and F. W. Reynolds, former acting chief of Commercial Standards, as assistant chief.

Edwin S. Webster, who in 1889 was one of the co-founders of the engineering firm of Stone & Webster, recently celebrated his 80th birthday (August 26). He organized the firm together with the late Charles A. Stone, a close friend and classmate. Born in Boston, Mr. Webster was graduated from Massachusetts Institute of Technology in 1888 with the degree of Bachelor of Science.

A further step in completing the technical organization of the Research and Development Division of Pittsburgh Consolidation Coal Co., was announced recently in the appointment of W. D. McElroy, 41, formerly of Philadelphia, as manager of the division's development department.

Dr. Wm. E. Wickenden, retiring president of Case Institute of Applied Science, Cleveland, has been named by the Engineers Joint Council as its representative on the United States Commission for UNESCO, it was announced at headquar-

Leaf Type **HEACON DAMPERS**



The Heacon Damper is fundamentally a tight sealing damper, designed to hold heat in the boiler when closed and to permit accurate control of the smaller increments by means of V-porting as it opens.

The "LH" or Leaf Type Heacon provides, at a lower cost, the advantages of tightness and control found in the SVH type Heacon Dampers and is particularly adaptable to smaller ducts.

The curtain in the LH type, as in the SVH, is of asbestos, held on the damper seals by the draft when closed and peels off (illustrated in inset) as it opens.

The basic difference in design between the LH and SVH Heacon Dampers is in the method of opening the damper. In the LH, the frame peels the curtain from the seals as it rotates away from the damper frame; while in the SVH Heacon type, the curtain is peeled from the seals as it is rolled upward. Obviously, the SVH type transmits no static torque to the operating spindle whereas there is a static torque in the LH operation.

Advantages of Heacon Dampers include: elimination of excessive leakage during shut down or banking periods . . . more accurate control with a consequent increase of range and output.

Our field engineers will be glad to show you the advantages of a Heacon Damper. Call or write the office nearest you.

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C. E. Johnson & Associate
Bona Allen Bldg.

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BUFFALO, N. Y.
Johnston Engineering Co.
1200 Niagara Street

CHARLOTTE 2, N. C.
T. C. Heyward
1408 Independence Bldg.

CHATTANOOGA 2, TENN.
Edgar A. Rogers
Chattanooga Bank Bldg.

CHICAGO 5, ILL.
Engineering Sales Co.
1307 S. Michigan Ave.

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H. W. Kaiser Co.
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KANSAS CITY, MO.
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2734 Cherry St.

LOS ANGELES, CALIF.
A. W. Anderson
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MINNEAPOLIS 2, MINN.
Hoyt A. Sevey
314 S. 9th St.

MONTREAL, CAN.
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Broad Street Station Bldg.

PITTSBURGH 19, PA.
Herr-Harris Co.
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Frank Howell Co.
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ROCHESTER 4, N. Y.
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WASHINGTON, D. C.
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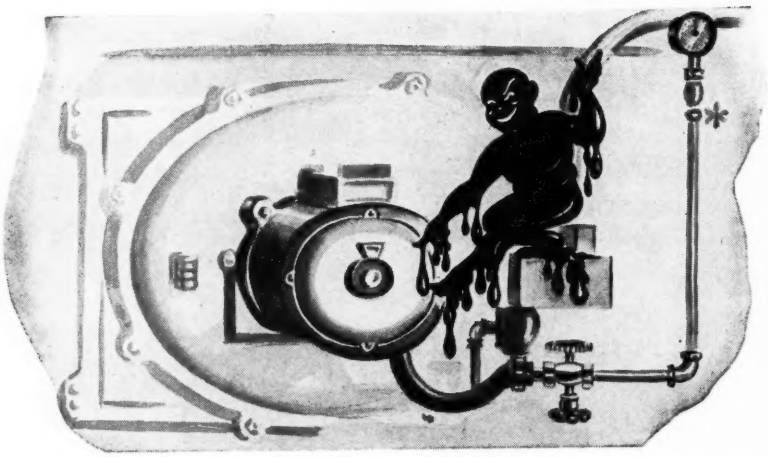
Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONNECTICUT

increase your oil-burning efficiency with Alken Certified EVEN-FLO



Stop plant losses due to sludge, carbonization and moisture in fuel oil systems. Large and small industries maintain a clean, efficient system from storage tank to burner nozzle by using ALKEN CERTIFIED EVEN-FLO*

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Representatives Located in Your Area
*Reg. U. S. Pat. Off.

WRITE FOR FREE SURVEY

ters of the council in the engineering societies building, 29 West 39th street. He is a past president of the American Institute of Electrical Engineers, and a former chairman of the Engineers Joint Council.

MANUFACTURERS' *News*

WILMETH ASSISTANT PRODUCTION CHIEF

THOMAS S. WILMETH has been named assistant production control manager of Allis-Chalmers general machinery, West Allis works, according to an announcement by E. W. Bonness, works manager. He succeeds R. L. Brueswitz, resigned.

Mr. Wilmeth, who holds a bachelor of science degree in electrical engineering from Purdue University, has been with Allis-Chalmers since January, 1936, during which time he has worked in the erection and engineering departments as well as the company's Boston, Pittsburgh and Norwood works. From 1938 to 1942 he served as sales engineer in Allis-Chalmers Bluefield, W. Va., office. Recently he had been assistant superintendent of material control. In his new post Mr. Wilmeth reports to William C. Krecklow, production control manager.

H. S. FALK ON ALLIS-CHALMERS BOARD

HAROLD S. FALK, president of The Falk Corp., recently was elected to the board of directors of Allis-Chalmers Manufacturing Co.

Mr. Falk, whose firm is widely known as a manufacturer of reduction gears and steel castings and as a large producer of gear units for World War II Navy vessels, succeeds his uncle, the late Herman Falk. Herman Falk was a member of the board for 14 years, and was chairman of the board of The Falk Corp. at the time of his death early this year.

The new director has been actively associated with The Falk Corp. since 1906, and was named president of the firm in 1940. He also holds directorships in The Heil Co., Northwestern Mutual Life Insurance Co., Wisconsin Electric Power Co., and several other companies. He was awarded the John Penton Medal by the American Foundrymen's Association in 1939.

GARDNER-DENVER SELLS GOVERNOR BUSINESS

IN THE interest of centering manufacturing facilities on its principal lines, Gardner-Denver Co. has sold its governor business to the Wiebmer Machine Shop of Quincy, Ill., Gardner-Denver officials recently announced. Gardner-Denver will henceforth concentrate on its business in rock drills, air compressors, pumps and other allied products.

STEINBRECH HEADS HERCULES FLOAT

EFFECTIVE August 1, 1947, The Hercules Float Works announces, John Steinbrech is taking over the management of that organization.

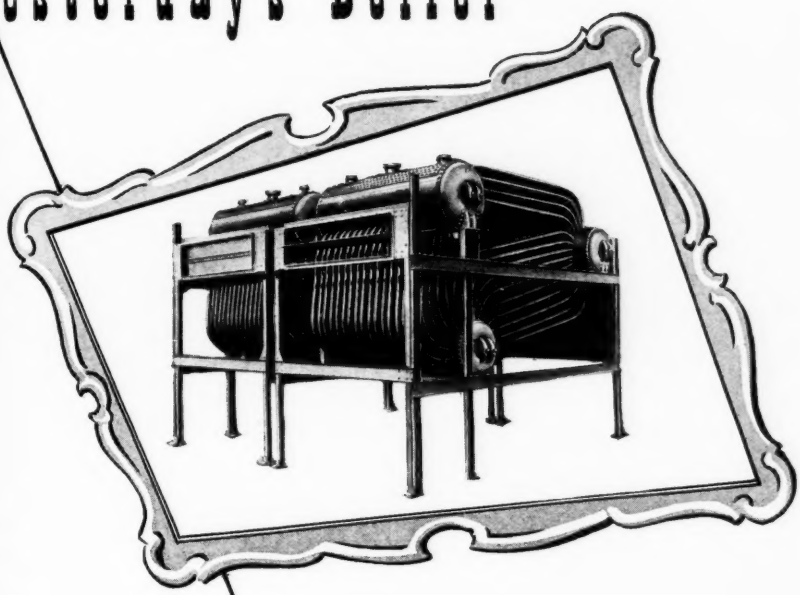
"PACKAGED" POWER FOR MEXICO

THE MANUFACTURE of ten 5000-kw unit power plants, a new engineering development that is greatly simplifying the installation of low cost electrical power plants, will begin soon in the Sunnyvale Works of the Westinghouse Electric Corp. at Sunnyvale, Calif.

The first four units to come from the plant, probably by mid-1948, are destined for Mexico. Others will see service in other parts of the world.

Highly compact and standardized, the

Yesterday's Boiler



still generates STEAM

BUT . . . your profits are determined by today's cost of fuels and cost of operation.

Consider what you pay for fuel today—two times what you paid before the war. Remember that operating labor rates have doubled since 1939.

However, technological advances during the last two decades have offset these increases to the extent that the average price of electricity today is lowest in the history of the industry.

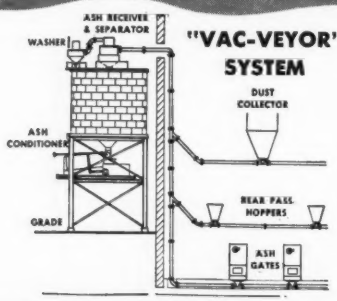
It stands to reason that you must have modern high efficiency steam generating equipment to be competitive in today's market.

Foster Wheeler's engineering "know how" is the answer to the pertinent question of how to reduce your operating costs.

FOSTER WHEELER CORPORATION

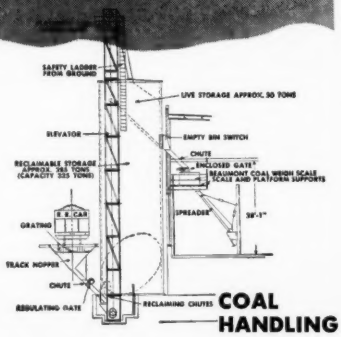
165 BROADWAY, NEW YORK 6, NEW YORK

Profits Saved AT EVERY STAGE . . . WITH BEAUMONT COAL & ASH HANDLING EQUIPMENT



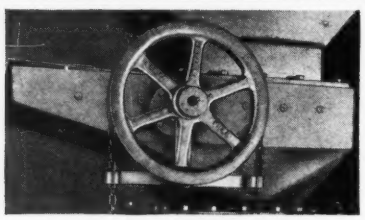
"VAC-VEYOR" SYSTEM

In this system, ashes, siftings, soot and dust are conveyed by pipe from the ash pits, dust collectors, stack, etc., to an ash receiver and separator at the top side of a silo—by means of a vacuum. One man operates the system, keeping your plant cleaner with less labor.



COAL HANDLING

Coal arrives by rail, is dumped into hopper, raised by bucket elevator and discharged either into bunker for immediate use or down chute to yard storage. One operator controls all equipment.

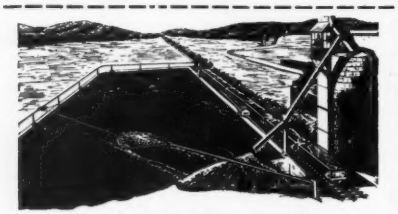


ROLLER BEARING GATE

Incorporating double rack and pinion for granular or powdered materials, these drip-proof self-cleaning gates will not corrode, bend or warp. Material cannot collect in back of gates—these ball bearing gates operate manually or electrically without strain or ramming.

AUTOMATIC WEIGHING SCALE

Accurately weighs coal and similar materials from 1 to 60 tons per hour. Vibrating feeder plate eliminates belts, pulleys and motors. Scale is totally enclosed, dustproof and quiet.



DRAG SCRAPER SYSTEM

Coal is dug evenly with minimum power consumption. Tail blocks can be slung between posts and moved by hand, mechanically moved on I-beam track by tail block car, or suspended from aerial bridge system. One man can operate entire system by remote control.

ASH HOPPERS AND GATES

Steel plate ash hoppers are low cost, rigid, unbreakable, watertight and, when lined with refractory material, resist temperature and erosion. Ash gates are designed for use on stoker and pulverizer ash hoppers where water sealing and draining is essential.

Beaumont engineers design and erect this and associated equipment—*a complete coal and ash handling system.* You save in installation as well as in handling. ONE CONTRACT—ONE RESPONSIBILITY—FOR BULK HANDLING SYSTEMS. Write for more information to:

BEAUMONT BIRCH Company

1503 RACE STREET—PHILADELPHIA 2, PENNA.

Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEM

power plants are completely self-contained units requiring only the addition of a building to house them. They operate with either coal or oil as fuel, at any altitudes between sea level and 6,000 ft, and are adapted to climates ranging from the Arctic to the Tropics.

GARRETSON RETIRING FROM LEEDS & NORTHRUP

L. R. GARRETSON, since 1925 Advertising Manager of Leeds & Northrup Co., has announced his retirement, which is made necessary by the condition of his health.

Mr. Garretson's career in advertising was firmly rooted in industry. With the Philadelphia Drying Machine Co. he was successively draftsman, salesman and advertising serviceman, an apprenticeship that served him well. Later he joined Collins Service, a Philadelphia firm specializing in syndicated advertising for banks, eventually becoming manager of the specialized advertising division.

Mr. Garretson is a past president of Eastern Industrial Advertisers, Philadelphia Chapter of the NIAA, and a former director and vice-president of the national association. He also belongs to the American Marketing Association and the American Management Association.

Mr. Garretson's successor is Kenneth W. Conners, who has been a member of the Advertising Division since 1934.

FAIRBANKS ADOPTS FIRM PRICE POLICY

IN AN EFFORT to aid in the stabilization of prices and to aid its customers and distributors, The Fairbanks Co. has announced the adoption of a firm basis for price quotations on all its orders after August 25, 1947. The prices quoted will be subject to acceptance within 15 days from the date of quotation and all valve products shipped on orders dated August 25 or later will be billed at prices in effect on the date the order was accepted or at the time of shipment, whichever is the lower.

E. A. WERT HEADS NEW CMH DIVISION

THE CHICAGO Metal Hose Corp. has appointed Edwin A. Wert as director of sales for their new Expansion Joint Division with offices in Maywood, Ill.

Mr. Wert, a national authority on piping design, was formerly with The Detroit Edison Co., where he had been engaged in an engineering and design capacity for eighteen years, and at present as honorary consulting engineer. He was responsible for the development of numerous technical contributions, including simplified formulae whereby economical piping layouts may be quickly conceived, eliminating hours of arduous study. He is the author of various publications in the power piping field.

For four years Mr. Wert was vice-president in charge of engineering and sales of Blaw-Knox Co., power piping division, and for several years he was consulting engineer for Pittsburgh Piping & Equipment Co.

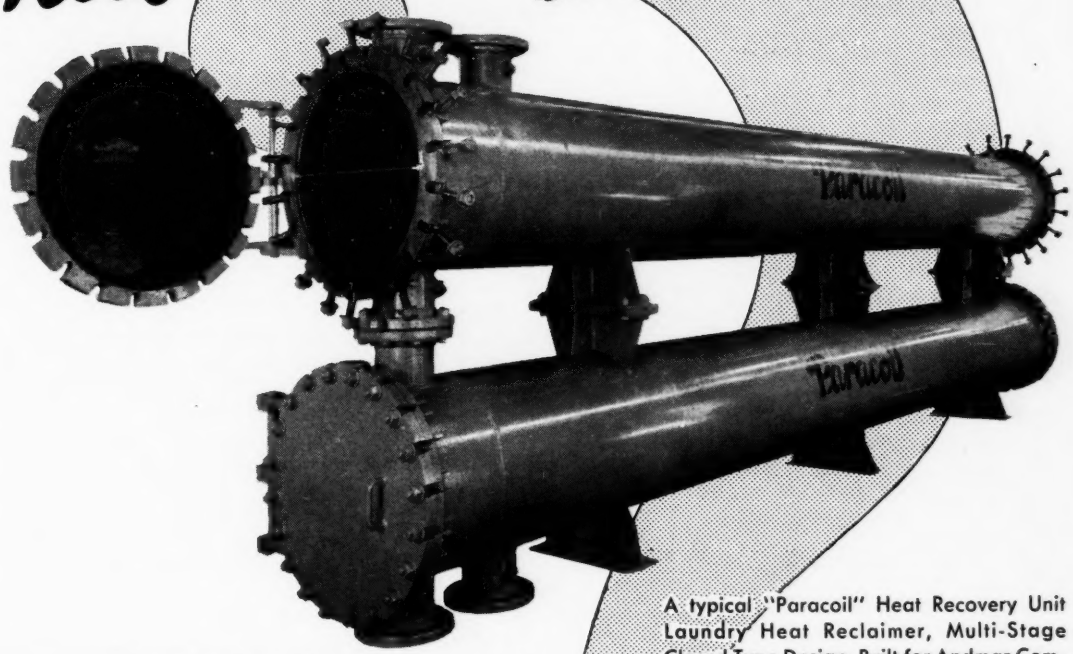
DR. RENTSCHLER RETIRES

DR. HARVEY C. RENTSCHLER retired recently after a 30-year career of directing Westinghouse lamp and electronic tube research at Bloomfield, N. J. As he turned over his records to his Westinghouse successor, Dr. Charles M. Slack, Dr. Rentschler had advice for young scientists bent on research as a career.

"The best research engineers I have known have been those whose minds are open to conviction and who are able to make their own decisions. Just because something is stated as a fact in the scientific literature is no positive proof that it is a truth. Formulae, equations and rules were made to be challenged and exist only because someone challenged former rules."

Dr. Rentschler resigned a faculty post at the University of Missouri, where he

What Price B.T.U.



A typical "Paracoil" Heat Recovery Unit Laundry Heat Reclaimer, Multi-Stage Closed Type Design. Built for Andmar Company, Engineers, New York.

Every steam plant in America—regardless of size and type, or nature of fuel—is faced with the certainty of rising fuel costs. Increased labor charges at mine and well, coupled with higher railroad and marine transportation tolls, indicate an inevitable upward trend in the cost of B.T.U.'s delivered.

PARACOIL HEAT EXCHANGERS have been fighting this tendency for years, by reducing fuel costs through recovery of waste heat. Wherever hot liquids or gases are being allowed to go to waste, there "PARACOIL" can do a fuel saving job, often at remarkably low initial cost.

"PARACOIL" EXCHANGERS for Waste Heat Recovery are available as:

BOILER BLOWDOWN EXCHANGERS · DIESEL EXHAUST GAS WASTE HEAT BOILERS* · WASTE CONDENSATE COOLERS LAUNDRY WASH-WATER RECLAIMERS · FEED WATER HEATERS PROCESS WASTE HEAT RECLAIMERS · LIQUID TO LIQUID EXCHANGERS · GAS TO LIQUID EXCHANGERS

*For those particularly interested in the recovery of waste heat in Diesel Engine Exhaust Gases, we have available our BULLETIN NO. 301. Copies will be sent to anyone writing on his company letterhead. We *solicit your inquiries.*

DAVIS
ENGINEERING CORPORATION
1064 East Grand Street, Elizabeth 4, N. J.
SAVE WITH "PARACOIL"

And both accomplished by skillfully engineered use of the same steam. This is Troy-Engberg By-Product Power at work.

Use the modern Troy-Engberg Steam Engine to drive stokers, blowers, fans, compressors, mixers, generators and pumps—THEN use the exhaust from the engine for your processing or heating, or both.

Cut Power Costs by putting your steam fully to WORK. Write us for detailed information on applying Troy-Engberg By-Product Power to your plant.

Send for Bulletin 306

TROY ENGINE & MACHINE COMPANY

Established 1870

800 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

had taught physics nine years, to join the Westinghouse Research Laboratories in East Pittsburgh, Pa., in 1917. A few years later he came to Bloomfield to establish the company's lamp research laboratories.

INDEX TO ASTM STANDARDS

THE AMERICAN Society for Testing Materials has announced its new "Index to ASTM Standards." This publication, issued in June, 1947, is really an adjunct to the 1946 Book of Standards and enables any of the some 1,400 standard specifications and tests in the volumes to be located readily. The Index is also of service to those who wish to determine whether ASTM has issued standard specifications, test methods, or definitions covering a particular engineering material or subject.

All items are listed in the Index under appropriate key-words according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numerical sequence of their serial designations.

Copies of the 242-page publication are furnished without charge on written request to ASTM Headquarters, 1916 Race street, Philadelphia 3, Pa.

EEI REPORTS ON CABLES AND BOILERS

TWO REPORTS have just been issued by Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.; one of them is "Boilers and Combustion, 1946," Publication No. O-12, and the second is "Cable Operation," Publication No. O-14. The former is available to members and their employees for $1 per copy, $2.50 to nonmembers in the United States, and $2.65 to foreign countries. The latter is 60c, $1.50 and $1.60, respectively.

EEI WATER HEATER MANUAL

AN ELECTRIC Water Heater Installation Manual, which illustrates the principal wiring methods and other installation practices now used with electric water heaters throughout the country, has just been prepared by the wiring committee of the commercial division, Edison Electric Institute, and published by EEI.

The Manual, which is the first section of a comprehensive Appliance Installation Manual to be prepared by the committee, to cover those appliances requiring a specific type of installation work, pictures the major variations of electric and plumbing connections found in the industry, according to R. F. Hartenstein, committee chairman.

A total of eight electric water heaters installation methods as developed for use with one meter are shown, together with several adaptations of the two meter method, and suggested plumbing diagrams. All installations covered utilize the standard two-element water heater, known as the NEMA standard.

The Electric Water Heater Installation Manual is available from Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y., at 50c per copy. Additional copies of the individual diagram are also available, for distribution to contractors and dealers, at $3 per hundred sheets.

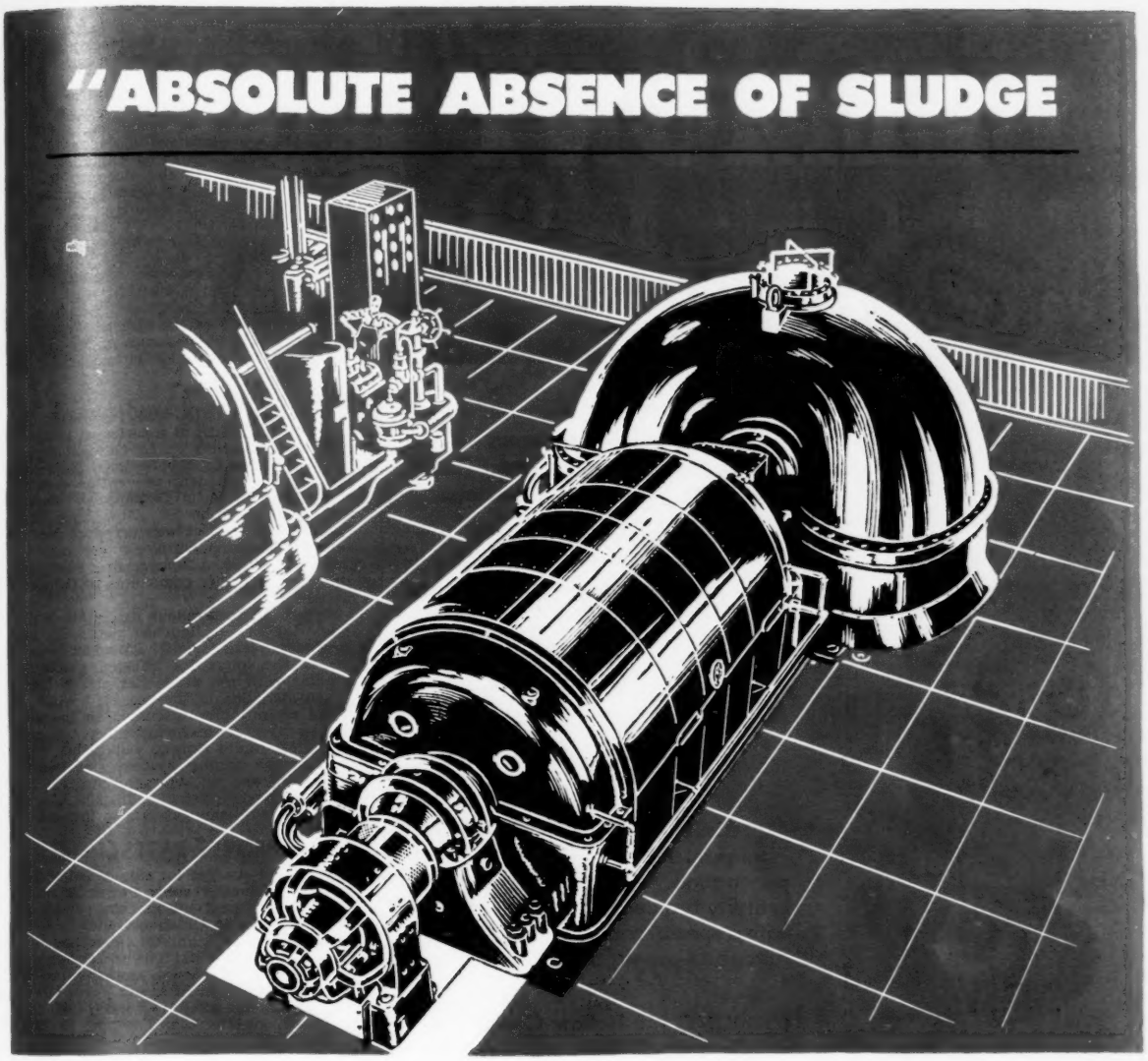
DOUGHERTY HEADS ASCE

RICHARD E. DOUGHERTY, White Plains, N. Y., vice-president of the New York Central Railroad, was nominated as the 1948 president of the American Society of Civil Engineers, at the summer convention of the Society's Board of Direction in Duluth, Minn.

Nomination tantamount to election will be confirmed late this year by letter ballot of the membership. Mr. Dougherty will take office at the Society's annual meeting in New York City next January.

A graduate of New York City's public schools, who attended the College of the City of New York three years, and was graduated from Columbia University in

"ABSOLUTE ABSENCE OF SLUDGE



...since using Tycol turbine oils"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N. Y.

"Ten years without an oil change...
Bearings show no sign of wear..."

These results are typical of the unusual performance achieved with Tycol Turbine Oils. Refined by a special process, these modern lubricants stand up under the toughest service conditions . . . retain their original characteristics.

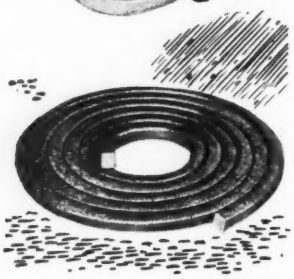
Call your nearest Tide Water Associated Office today for full information about the time- and money-saving advantages of Tycol Turbine Oils. Rust inhibited *Tycol RIO Turbine Oils* are also available for operations where corrosion is a factor.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

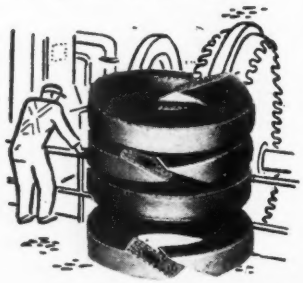
BELMONT
PACKINGS
solve sealing problems

These three packings are representative of the extra values built into each product in the complete Belmont line. For every service . . . steam, water, oil, gas, acids, alkalis, ammonia . . . your Belmont Distributor has the right packing.

BELMONT #30 For High Pressure Steam Rods and Expansion Joints. Center block pleated on itself (accordion fashion) at approx. 90° angle with rod, affording, high resiliency and flexibility, extra take-up, extra "edge wear" if packing wears toward the rod.



BELMONT #189 For Hot Oil Rods and Plungers. Has extra resistance to penetration. Long-fibre asbestos yarn is firmly braided, each strand treated with a special compound so that saturation and penetration are minimized.



BELMONT #19 Hollow Center Packing For Intermediate and Low Pressure Steam; Hot and Cold Water Rods and Plungers. Hollow Center permits expansion and contraction. Packing "breathes" toward the hole, so friction is kept at minimum point created by the working pressure itself.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

Belmont Packings are available in every large industrial center, through Belmont Distributors.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

1901, Mr. Dougherty was an instructor in the department of civil engineering at Columbia in 1901 and 1902, and a special lecturer at Cooper Union from 1916 to 1920.

Mr. Dougherty has been in the service of the New York Central System since 1902. He started as a rodman, operated a transit, was assistant engineer on construction work, designing engineer, engineering assistant to the vice-president in charge of operations, and engineering assistant to the president of the lines prior to his election to the office of vice-president in charge of improvement and development on February 1, 1930. He is chairman of the Research Council of the New York Central System for the considering of post war problems. He is vice-president of 41 of the railroad and real estate subsidiary companies of the system and director of 22 subsidiaries.

SAFETY BOOKLET

"SAFE USE of Liquefied Petroleum Gas in Industry," sixth of a series of informative safety booklets on LP-Gases, has just been published by the National Conservation Bureau, accident prevention division of the Association of Casualty and Surety Companes, 60 John St., New York City. The 18-page booklet was prepared by the bureau's liquefied petroleum gas research committee, a group composed of safety engineers of member companies of the association.

Because of tremendous expansion in the industrial use of liquefied petroleum gas in recent years, says the booklet, everyone in the industries affected should be familiar with the properties and methods of safe handling of the gas.

The main topics discussed in the new booklet are: Transportation of the gas, unloading, liquid storage, vaporizing, combustion and piping systems, utilization, conversion and accident and fire prevention. A lengthy list of industrial uses of liquefied petroleum gas is also included.

FPC APPROVES RATES

RATES and charges for sale of power and energy by Southwestern Power Administration from the Denison Dam project on the Red River in Oklahoma and Texas to Texas Power & Light Co. have been approved by the Federal Power Commission. The rates and charges contained in an agreement between SPA and Texas Power & Light became effective July 7, 1947, and terminate not later than February 13, 1953.

ENGINEERS NAME ADVISORY GROUP TO STATE DEPARTMENT

THE ENGINEERS Joint Council, acting on a request of the State Department, has established a five-man advisory committee with a twofold purpose: to serve as a consultative and advisory group to the State Department as and when requested; and in a similar way to serve the Engineers Joint Council representative on the U. S. National Commission on UNESCO, who is shortly to be named.

KEEFER JOINS STANDARDS COUNCIL

W. DEAN KEEFER, vice-president, Lumbermen's Mutual Casualty Co., Chicago, has been appointed a member of the Standards Council, top technical body of the American Standards Association, P. G. Agnew, vice-president, has announced.

Mr. Keefer succeeds the late Walter S. Paine for his unexpired term ending December, 1949, and represents the National Safety Council.

EXPOSITION OF CHEMICAL INDUSTRIES

INTEREST has developed in the 21st Exposition of Chemical Industries denoting unusual activity in industrial planning and the projection of new enterprises far into

(Continued on page 170)

ROTO WATER JET

The most powerful and economical water-driven tube cleaner ever built

To our best knowledge no other water-driven tube cleaner develops such great power, and so economically, as the new ROTOJET. It is, by far, the most powerful and economical water-driven tube cleaner ever sold.

The ROTOJET water-driven Motor is brand new in design and construction. With equal water consumption, it develops over 100% more horsepower than the old Roto water-driven motor. This increased power and efficiency gives you, for the first time, a water-driven tube cleaner that removes the most stubborn scale quickly and thoroughly.

ROTOJET motors are available for the most popular tube sizes. Other sizes will be available shortly. Existing Roto heads and hose fit the new ROTOJET motors.

The new ROTOJET will save you enough on labor and water alone to pay for itself on a single tube cleaning job. And that's not figuring what you'll gain by putting your unit back on the line hours sooner.

Send for details and prices.

ROTOJET Water-driven Motor Model 321 with short 4-arm head and universal joint for 2⅝" I.D. curved tubes.

And

If Compressed Air Is Available, Get

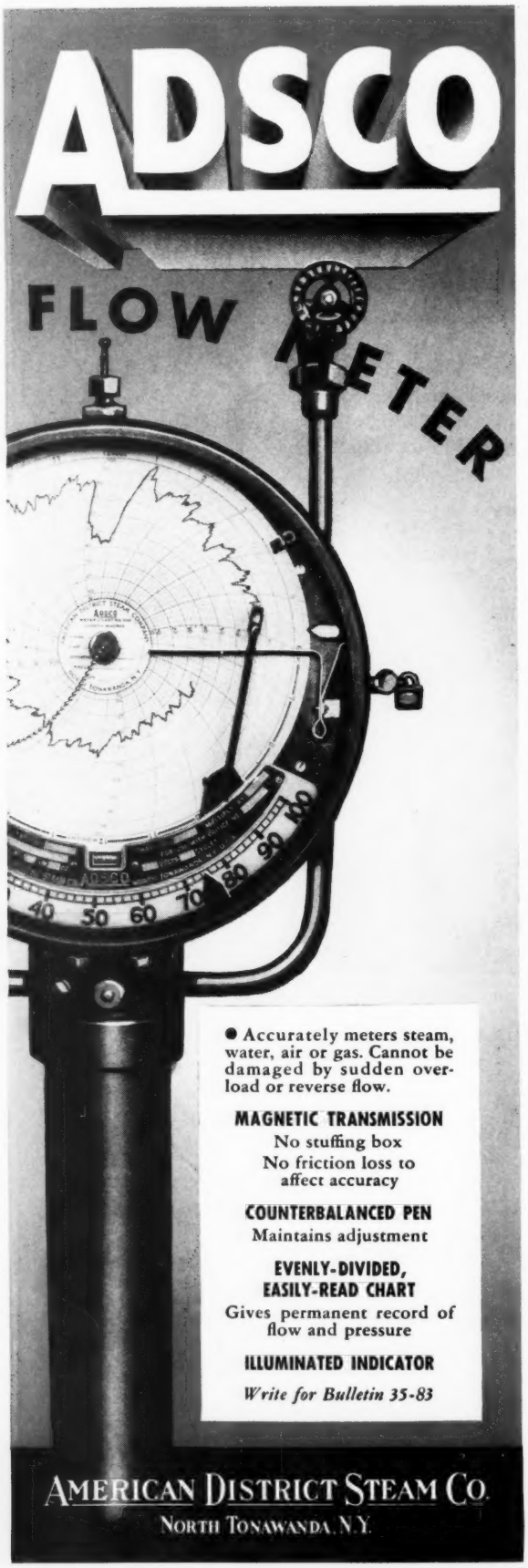
The New

ROTOJET

Air-Driven Tube Cleaner

ROTO Division of ELLIOTT COMPANY

147 SUSSEX AVENUE - - - NEWARK 1, N. J.



● Accurately meters steam, water, air or gas. Cannot be damaged by sudden overload or reverse flow.

MAGNETIC TRANSMISSION
No stuffing box
No friction loss to affect accuracy

COUNTERBALANCED PEN
Maintains adjustment

EVENLY-DIVIDED, EASILY-READ CHART
Gives permanent record of flow and pressure

ILLUMINATED INDICATOR

Write for Bulletin 35-83

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

ENGINEERS' PREVIEW

MULTIPLE OPERATIONS controller starts, times, correlates, stops multiple operations in any process or machine cycle actuated by electricity or air pressure, provides unlimited scheduling flexibility, to be varied at will without use of tools and without changing any parts. Air control is integral, does not require solenoid valves, pilot valve action is rapid. The time selector wheel carries 150 keys to provide timing of each successive event. Standard cycles are available to 750 minutes. At completion of program resetting is automatic. Developed to control rubber and plastic, molding offers equal savings to chemical, food or other batch processors.

★ ★ ★

ONE-PIECE FLEXIBLE couplings for special small-load uses in seven sizes for 1/16 to 1 hp, also miniature 1/50 hp rating, consist of neoprene core bonded to the metal hubs, giving maximum torsional flexibility, simplicity, low cost and other advantages.

★ ★ ★

LIGHT-DUTY Rexon vibration mounts use the rubber-in-shear principle, with no possibility of overloading the shear elements. Furnished in 12-in. strips used entire or cut to suit load and conditions. Drilled lugs can be positioned to fit almost any type of mounting.

★ ★ ★

SMALL GENERAL-PURPOSE 1/10-hp a-c and d-c motor turning 5000 rpm, has 3/8-in. shaft extending both directions, is equipped with double ball bearings, requires no lubrication. With three-step pulley, foot rheostat, reversing switch—$35.

★ ★ ★

A BABY turbo-prop gas turbine for small aircraft, boats, other power uses, Model 502 weighs 140 lb, delivers 200 hp to the shaft plus 50 lb thrust produced by the exhaust. This new unit is 42 in. long by 22 in. maximum diameter, is of the two-burner type.

★ ★ ★

A PRESSURE GAGE featuring a beryllium-copper Bourdon tube and cones screwed at at tip and socket, equipped with a recalibrator against the remote possibility of being knocked out of adjustment, is recommended for use with almost all corrosive liquids, in mills and plants of all kinds.

★ ★ ★

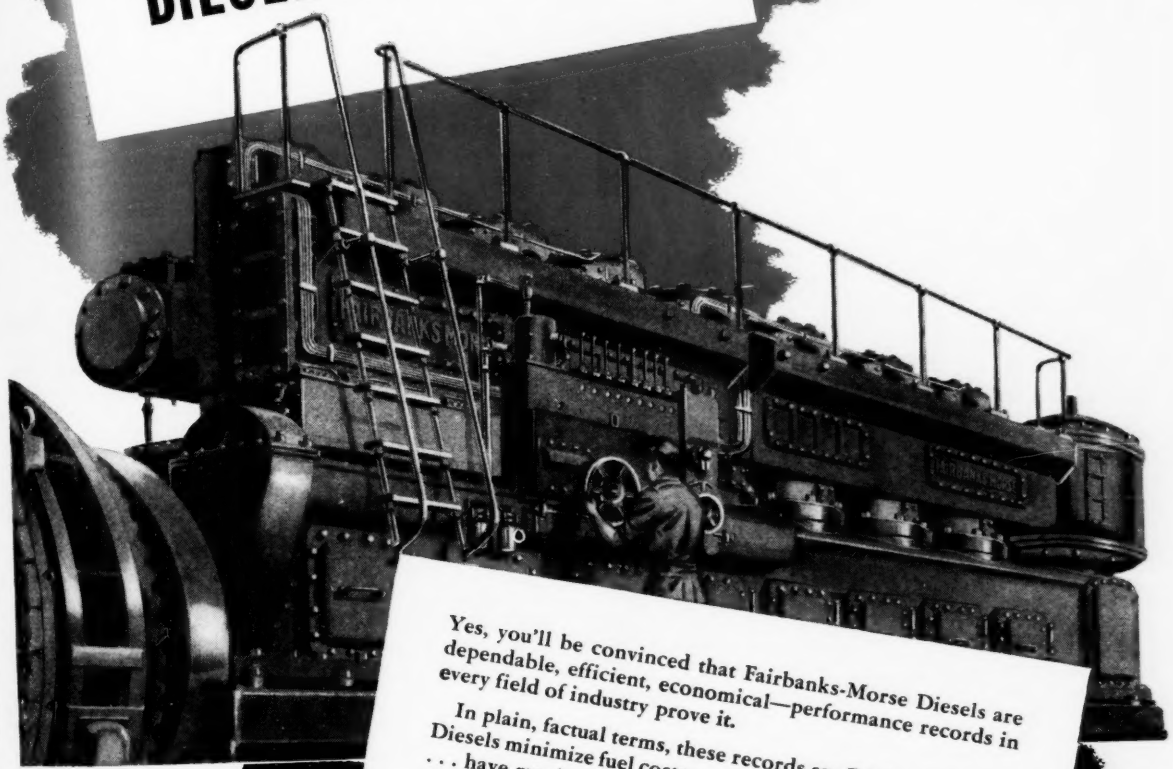
THE SERVICE telescopic container lifter with quick-operating container harness and snap-on discharge hood, makes raising and dumping easier and safer. Capacities to 2000 lb in hand or power-operated types. Usable on all liquid and granular materials, into mixing and storage tanks.

★ ★ ★

PORTABLE HIGH-PRESSURE pump carrying rubber impellers, has a self-contained one-cylinder air-cooled 5 hp power plans, pump mounted directly on the engine with power transmission through a splined sleeve. It delivers 40 gpm at 120 psi, has a suction lift of 30 ft.

Look at the record for proof of

FAIRBANKS-MORSE DIESEL SUPERIORITY



Yes, you'll be convinced that Fairbanks-Morse Diesels are dependable, efficient, economical—performance records in every field of industry prove it.

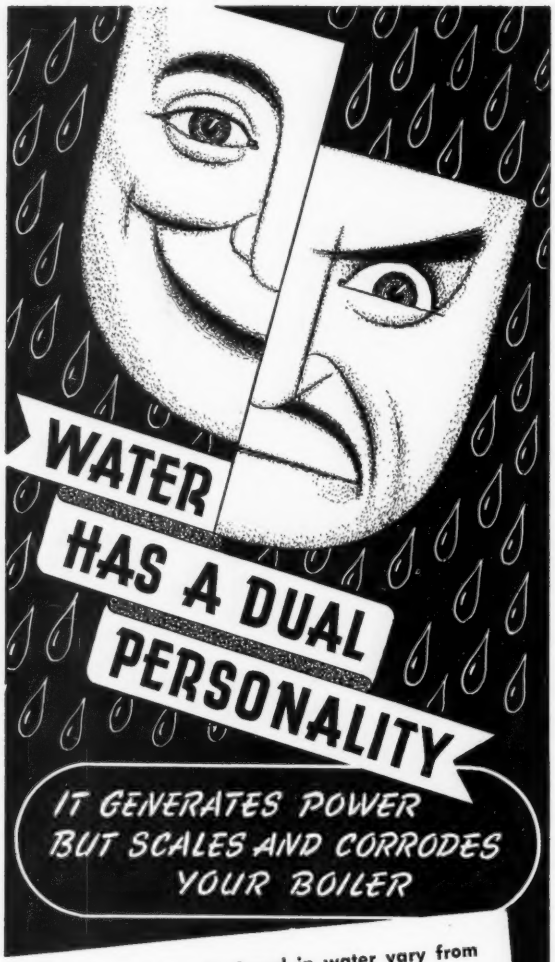
In plain, factual terms, these records say Fairbanks-Morse Diesels minimize fuel costs . . . keep maintenance costs down . . . have maximum reserve power . . . give sustained heavy-duty service even under extreme conditions.

Will they do the same for you? There is every reason they will—no matter what your power requirements are. Remember—diesels save fuel because they generate more power per gallon than any other power producer that uses oil. A Fairbanks-Morse engineer will be glad to talk over your problems with you. Write today for full particulars. Fairbanks, Morse & Co., Chicago 5, Illinois.

Diesel Locomotives
Diesel Engines
Generators • Motors
Pumps • Scales
Magnetos • Stokers
Railroad Motor Cars
and Standpipes
Farm Equipment

Fairbanks-Morse

A name worth remembering



● Chemical deposits found in water vary from place to place and from time to time.
● Your Boiler Feedwater Treatment must be individually prepared to cope with the water problems in your locality. It must be periodically checked to observe chemical changes. It must be geared to your operating conditions.
● DRY PINK Boiler Feedwater Treatment is an individual formula prepared by our Chemical and Engineering Staff after a complete analysis of your boiler feedwater is made. This scientific product will dissolve and remove scale now present. It will prevent further accumulation of scale and corrosion.
● Our work does not end with the preparation of the special DRY PINK formula. The work is carried on by the coordinated efforts of the Service Technicians working in the field, and our Laboratory Technicians. Periodical check-ups are made in your plant. Your boiler room equipment is inspected and recommendations are made for the maximum boiler efficiency.
● To prolong the life of your boiler—to increase its efficiency—to reduce fuel and maintenance costs—use DRY PINK. Write for full particulars.

Dominion CHEMICAL CO., Inc.
WATER CONSULTANTS AND CHEMISTS
FOR INDUSTRIAL AMERICA
11 WEST 42nd ST. • NEW YORK 18, N.Y.

DESIGNED TO grip or release V belts directly, an ingenious friction drive clutch includes the Ball-Lok clutch units complete in themselves, may be used or on driving or driven pulleys. One fixed flange on V-belt sheave is an integrally-attached part of the hub forms inner race of sealed ball bearing idler. Four free-rolling balls ride in grooves carrying all turning and locking forces, balls are carried forward by slidable clutch sleeve or movable outer flange, drop into pockets in ends of grooves. Cam sleeve moves clutch sleeve over and locks it against balls. All parts turn with shaft. Smooth positive clutching action, no drag nor creep on release, are claimed. Of four sizes, sheave diameters 3¼ to 5-in., two may be applied to ¾-in. shafts, others to 1-in. Heavier duty units will be available shortly.

★ ★ ★

THE CYCLONE BURNER may bring about a revolution in the power field—not atomic energy, the gas turbine, underground coal gasification, compression distillations or any of a dozen other developments that are being groomed for this role. That is the opinion of a number of top-flight power engineers, as expressed to us recently. The cyclone burner, they say, is already here and in successful operation; whereas the other items enumerated above are all in the experimental and development stage. For evidence, they point not only to the successful operation of the first experimental cyclone burner at the Calumet Station of Commonwealth Edison Co. but also to the recent announcement by the company that the cyclone burner will constitute standard equipment on all additions to its generating capacity.

It is announced that the new 150,000-kw generating unit for Fisk Station will be supplied with steam by two boilers, each of 75,000 lb per hr capacity, and each fired by four cyclone burners. Commonwealth Edison is also planning another new and large capacity unit; studies for its location are now being made. Consideration is also being given to installation of cyclone burners on additional units now being planned for the Joliet and Waukegan stations of Public Service Company of Northern Illinois. Finally, a large industrial company is going ahead with plans for a 400,000-lb-per-hr, 1250-psi steam generating unit to be fired by cyclone burners.

Successful operation of this burner is the climax of 12 years of development work by The Babcock and Wilcox Co. and the first installation of it at Calumet Station results from close collaboration in recent years between Babcock and Wilcox, Sargent & Lundy, consulting engineers and the Commonwealth Edison Co.

★ ★ ★

BETTER METALS, better oils and better bearings have now reduced friction to the status of a minor annoyance instead of a foe that has plagued mankind since the invention of the wheel, William L. Batt, president of SKF Industries, Inc., Philadelphia, said at the opening of the first National Tool Show since 1935, held in Chicago September 17 to 26. The new developments, said Batt, mean that many standard machine tools can now operate accurately at speeds ranging from 50,000 to 75,000 rpm in everyday shop practice, as compared with average speeds of only 20,000 to 30,000 rpm some 15 or 20 years ago. He cited as an example of progress the recent development of a new electric motor, with a control system employing hydrogen-filled thyraton tubes, which has recorded speeds up to 120,000 rpm.

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

Wide Double Contact Surfaces— Spring Tension Locking of Links

WARE HI-LAG Fuses provide extra wide contact surfaces on both sides of links and stronger connections. Link connections are held firm and tight at all times by large arched spring steel washers and heavy studded bolt, which locks the links into the circuit.

Expansion and contraction of metals during *Off* and *On* periods compress links. This fluctuation causes loose contacts and oxidization in other fuses, which finally result in excessive heating and unnecessary blows. WARE HI-LAG construction keeps contacts permanently tight, thus insuring low resistance and longer fuse life.

WARE HI-LAG has many exclusive features in addition to the above; including the Link Design-Double Bridge Knife-Blade Assembly-Gas Vents and Simplified Construction, only 3 Parts. That is why it is known as the World's Best and Coolest Operating Fuse made.

We manufacture all of our own parts and are making prompt deliveries.

Write for Brochure giving details of all the COOL FACTS, sizes and prices.

KNIFE-BLADE
250 VOLTS
600 VOLTS
70 to 600 AMPS.

FERRULE
250 VOLTS
600 VOLTS
3 to 60 AMPS.

APPROVED BY UNDERWRITERS' LABORATORIES

WARE Brothers 4450 W. LAKE ST.·· CHICAGO 24, ILL.

LUBRIPLATE maintains a durable, load carrying film at the "Friction Point," which reduces friction, retards progressive wear and prevents rust and corrosion. That is why gears lubricated with LUBRIPLATE last longer and run better. Don't take our word for it. Prove it to yourself. Thousands have in every industry.

LUBRIPLATE

Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

LUBRIPLATE

FISKE BROTHERS REFINING CO.

NEWARK 5, N. J. TOLEDO 2, OHIO

DEALERS FROM COAST TO COAST

CONSULT YOUR CLASSIFIED TELEPHONE BOOK

MANUFACTURERS' NEWS

(Continued from page 164)

the future. Although the exposition will not be held until December 1 to 6, space reservations already assure the complete occupancy of four floors of Grand Central Palace, New York City, where the exposition will take place.

The display of processing equipment will be more comprehensive than usual, with many new developments to be disclosed. Raw and fabricated materials, standard mill units, such as valves and piping, shafting, pulleys, belts, clutches and couplings, transmissions, conveyors, motors, pumps, and others will be shown in great variety.

Chemical industries and chemical processes used in connection with the operation of mechanical industries afford applications of interest to visitors from almost every branch of productive activity. Equipment suitable for some part of almost every kind of manufacturing plant will be found in the roster of exhibits.

SOUND MOTION PICTURE EXPLAINS RF HEATING

PRINCIPLES and applications of radio frequency heating in industry are explained in a new 16 mm sound motion picture filmed by Westinghouse. The movie is about 40 minutes long, and divided into two parts.

In Part One, the theory of induction heating is completely explained with easy-to-understand animation. This explanation is followed by a series of practical sequences which illustrate the use of induction heating for soldering, brazing, annealing and hardening.

In similar manner, the theory of dielectric heating is explained in the second section. This is followed by a series of industrial application stories dealing with preheating of plastic preforms, bonding of laminates and plywood, textile drying and twist setting, curing and drying of rubber, and other applications.

The film is available without charge from the Film Section, Westinghouse Electric Corp., 511 Wood Street, Box 868, Pittsburgh 30, Pa.

TILE ENGINEERING

PUBLICATION OF "Tile Engineering," a handbook for users of structural clay tile, including facing tile, is announced by the Structural Clay Products Institute, Washington, D. C. The new volume, which contains 453 pages, is intended principally for architects, engineers and contractors.

The handbook describes the shapes and sizes of the tile and its principal properties with respect to color, texture, weight, absorption, porosity, resistance to freezing and thawing, compressive strength, etc.

It contains detailed information and recommendations regarding mortar, the design and properties of structural tile walls, and the design and construction of walls, partitions, footings, foundations, piers and pilasters.

Fire-resisting properties and methods of furring also are described in detail, together with methods of constructing and using pre-cast tile beams for floors and roofs utilized in all-masonry homes and other structures.

An appendix contains estimating tables and specifications for various kinds of tile construction.

PANEL HEATING SESSION

RECENTLY the newly appointed Committee on Panel Heating of the ASHVE held an all-day session at the Society's research laboratory in Cleveland, O. The meeting was conducted under the chairmanship of G. D. Winans, assistant superintendent of central heating, Detroit Edison Co., Detroit, Mich., and was called as the first step in the ASHVE Panel Heating Research Program.

Members of the research laboratory

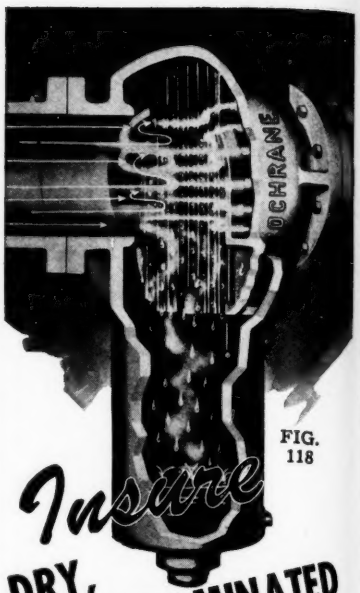


FIG. 118

Insure DRY, UNCONTAMINATED STEAM with

COCHRANE
SINCE 1863

ALL-SERVICE SEPARATORS

Where the flow of steam is horizontal, the Fig. 118 Cochrane All-Service Separator is used for the elimination of moisture or oil. Cochrane Separators are the most widely used and most successful type of separator. At least 50,000 are in daily use, removing oil or moisture from steam or air. The separator has exceptional port area, is self-cleaning, one-piece construction. The condensate chamber is of large capacity and the baffle is so designed that the purified steam or air does not come in contact again with the entrainment.

Write for Publication 2950.

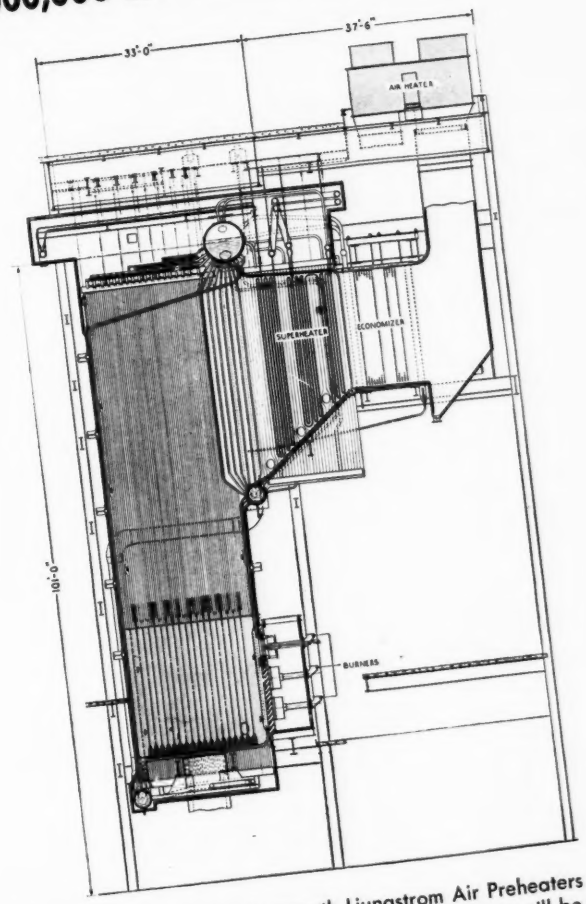
COCHRANE CORPORATION
3123 North 17th St., Phila. 32, Pa.

COCHRANE STEAM SPECIALTIES

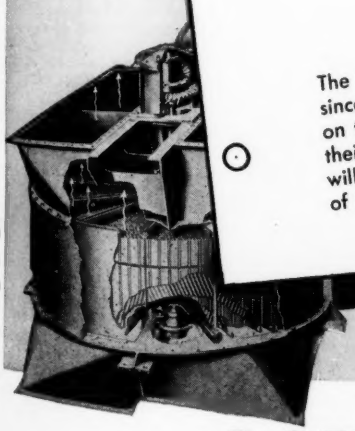
ENGINEERING PROGRESS REPORT #14

LJUNGSTROM AIR PREHEATER

NEW 1,000,000-LB. STEAM GENERATING UNIT



The twenty-sixth and twenty-seventh Ljungstrom Air Preheaters ordered since 1927 by Public Service Electric and Gas Company will be installed on the new 1,000,000 pounds per hour Babcock and Wilcox boiler in their Essex Generating Station at Newark, N. J. These two Ljungstroms will supply preheated air at 730 F. with full-load exit-gas temperature of 347 F.



THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Before and After Views Show How

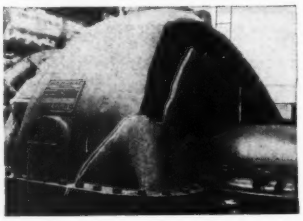
METALOCK REPAIRS

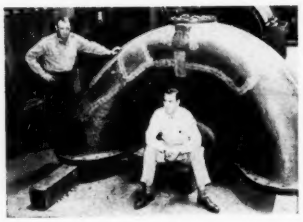
Put Power Equipment Back in Production Quicker, at Lower Cost

Study these views of broken and cracked frames and cylinder blocks. They will give you an idea of the big savings in time and money Metalock casting repair service is delivering in plants all over the country. . . . Metalock repairs, made only by workmen thoroughly trained in this patented process, have been proved and accepted by manufacturers, users, underwriters.

10,000 KW. STEAM TURBINE

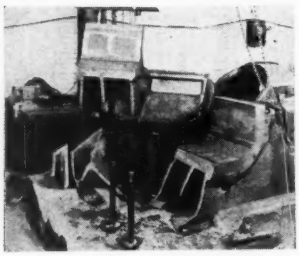
Before **After**

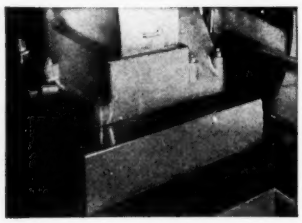




LARGE COMPRESSOR FRAME

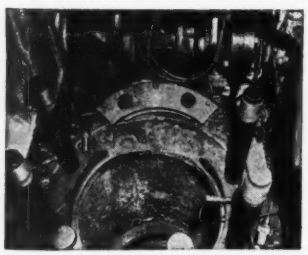
Before **After**

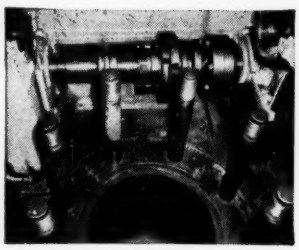




32 IN. DIA. DIESEL ENGINE BLOCK

Before **After**





Send for FREE Illustrated Metalock Booklet No. 104 Showing 50 Typical Illustrations. Service in any part of U.S.A., Canada, England, Norway. Agents Wanted.

METALOCK CASTING REPAIR SERVICE

Home Office: 36-15 48th Avenue, Long Island City, N. Y.

staff reported results of a review and critical analysis of published data on the design of panel heating. This survey was made as a result of recommendations of the March conference group which was called for the purpose of discussing the proposed panel heating research program. Laboratory staff members also presented a summary of a field survey on the subject.

The committee designated four principal divisions for future research on the subject of panel heating. The divisions include heat distribution within and behind the panel, heat transfer between the panel and the space, comfort conditions and controls.

The International Liaison Committee of the Second Instrument Conference and Exhibit extended invitations to engineers of all countries to attend the Second National Instrument Conference and Exhibit at the Stevens hotel, Chicago, September 8-12, 1947. Arrangements will be made with the Stevens hotel, Chicago, so that foreign visitors arriving in Chicago before the conference and remaining for a short time after the conference can have the use of their hotel rooms during the whole period of their stay.

Dr. Douglas F. Miner has been appointed director of the Division of Student Personnel and Welfare at the Carnegie Institute of Technology, President Robert E. Doherty announced today.

William C. Krecklow, who started with Allis-Chalmers in 1910 as an office boy, has been named production control manager of the company's West Allis general machinery works, according to an announcement by E. W. Bonness, West Allis Works manager. He succeeds Harold A. Wallace, who has resigned. Mr. Krecklow is succeeded as electrical manufacturing division superintendent by Arthur A. Ryan, who has been serving as general foreman in the company's electrical shops.

Peter Colefax, president of the American Potash & Chemical Corp., recently announced the appointment of Robert B. Coons of the company's executive staff to the post of vice-president. Mr. Coons, formerly senior partner with Coons, Milton and Co., joined American Potash & Chemical Corp. last year as assistant to the president.

Liquid Conditioning Corp. announces the appointment of M. J. Rahiya as its engineering sales and service representative in Louisville, Ky. The Rahiya organization specializes in utility and process engineering and contracting work, and has had extensive experience with the special water requirements of this territory.

MANUFACTURERS' *Personals*

R-S Products Corp., Philadelphia, recently announced the promotion of David W. Hopkins to Executive Vice President, giving him full administrative authority in the Valve, Furnace and Manufacturing Divisions.

A. M. Kuehmsted, chief engineer for the Santa Fe Tank and Tower Co. in Los Angeles for the past 12 years, has been assigned to the New York branch. Mr. Kuehmsted's new assignment became effective July 19. He will take over the district management of cooling towers, air cooled units, and wood tanks at Santa Fe's New York office, 400 Madison Avenue.

Jack Green, Sales Manager of the Welding Fittings Division of Tube Turns, Inc.,

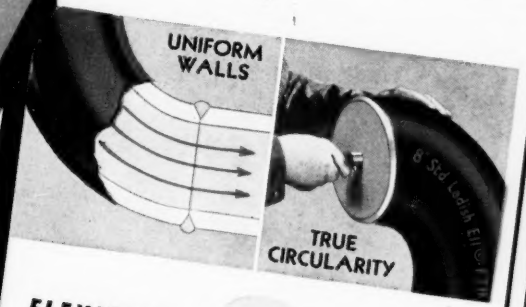
You Reduce ERECTION Costs

...When You Install LADISH Seamless Welding Fittings

THESE 4 WAYS

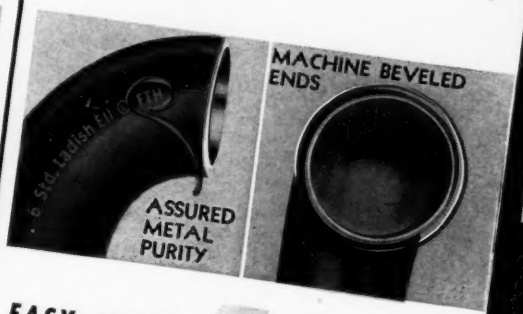
RAPID, POSITIVE ALIGNMENT...

Installation is swift and sure with sound, uniform welds at lower cost through the rapid, positive alignment of Ladish Seamless Welding Fittings. Matching the pipe accurately in both wall thickness and circularity, OD alignment insures perfect ID alignment . . . offsets are eliminated and smooth, uninterrupted flow results without the danger of erosion pockets.



SOUND, UNIFORMLY FAST WELDS

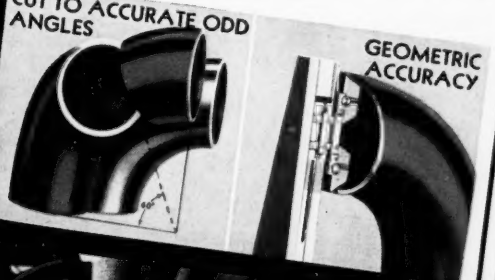
Strong, sound welds are an important installation economy which results from controlled metal purity and accurate, machine-beveled ends of Ladish Seamless Welding Fittings. Rigid metallurgical controls—evidenced by the Ladish heat code—safeguard against impurities such as slag and sulphur, thereby assuring the uniform weldability of every Ladish Fitting.



FLEXIBILITY IN PIPING DESIGN

Ladish Seamless Welding Fittings offer the thrift that goes with complete flexibility in piping system design.

True circularity permits cutting odd-angle sections for special piping makeup . . . while geometric accuracy facilitates economical prefabrication of large, complicated sections on the ground with assurance that they will fit perfectly into the system.



EASY, ECONOMICAL INSULATION

As easily covered as the pipe itself, Ladish Seamless Welding Fittings assure important savings in erection costs by simplifying the application of insulation. Smooth, unbroken surfaces require no special treatment to increase application costs. Since their welded joints are permanent, no provision is necessary for removal of insulation to inspect, repair or tighten joints.

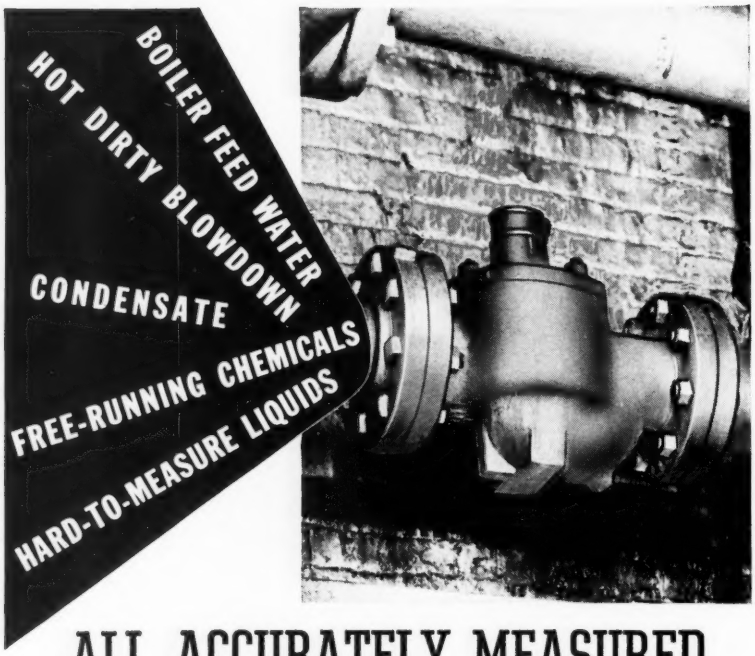
Controlled Quality FITTINGS

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES:
New York • Buffalo • Pittsburgh • Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

XUM

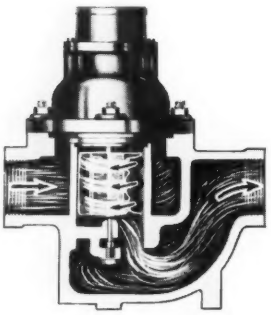


ALL ACCURATELY MEASURED

with a

HENSZEY *Feed Water* METER

These simple, rugged meters can be installed right in the line without additional structural supports. The straight reading horizontal register accurately records any liquid at high or low flow — high or low pressure — on centrifugal or reciprocating pumps. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature.



For your tough liquid measuring job, where stamina with accuracy is required . . . consider a Henszey Meter. Contact your nearest Henszey Representative or write to

HENSZEY COMPANY
DEPT. C10, WATERTOWN, WISCONSIN

SIMPLICITY WITH ACCURACY

Liquid enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each unit of liquid passing through this chamber makes the same number of revolutions. A vane placed in the liquid imparts this rotation to the calibrated register. A minimum of working parts without close clearances.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Boiler Feed Regulators • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Louisville, Ky., has announced the appointment of Lewis M. Bound, Jr., as West Coast Manager, with headquarters in San Francisco. Mr. Bound will assume his new duties on September 1.

The Whiton Machine Co. of New London, Conn. (formerly the D. E. Whiton Machine Co.), announces the appointment of Thomas G. Hart as general sales manager in charge of sales of steam turbines and other products. Mr. Hart was formerly general sales manager of the Terry Steam Turbine Co. of Hartford, Conn.

Harbison-Walker Refractories Co. has announced the appointment of Edward M. Sarraf as district sales manager at its Cleveland office. Mr. Sarraf's headquarters will be at 1505 Rockefeller Bldg.

Appointment of Robert O. Bullard as manager of the metallurgy division of General Electric's Chemical Department was announced recently. Mr. Bullard has been engineering and manufacturing manager of the metallurgy division since last November, four months after the division was established as the third operating unit of the chemical department, with responsibility for the manufacture and sale of permanent magnets and metallurgical products.

Three changes in personnel of district offices of SKF Industries, Inc., have been announced. They include appointment of Roy C. Norton, Jr., as a field engineer in the Hartford, Conn., district office; the transfer of I. J. Torkelson, field engineer, from Chicago to the firm's branch at Milwaukee, and appointment of R. M. Parrish to the sales staff of the Portland, Ore., district office.

Askania Regulator Co. has announced the appointment of Wilber F. Pray as New York district manager. Mr. Pray has been associated with Askania since the inception of the company. The New York district office will be located in the General Precision Equipment Corp. (Askania's parent company) Building, 92 Gold Street, New York 11, N. Y.

Lyle A. Christensen has been promoted to general sales manager of the Marley Co., Inc. Mr. Christensen served as sales engineer in the New York office of the Marley Co. for five years before assuming his new position at the home office in Kansas City.

New ENGINEERING BOOKS

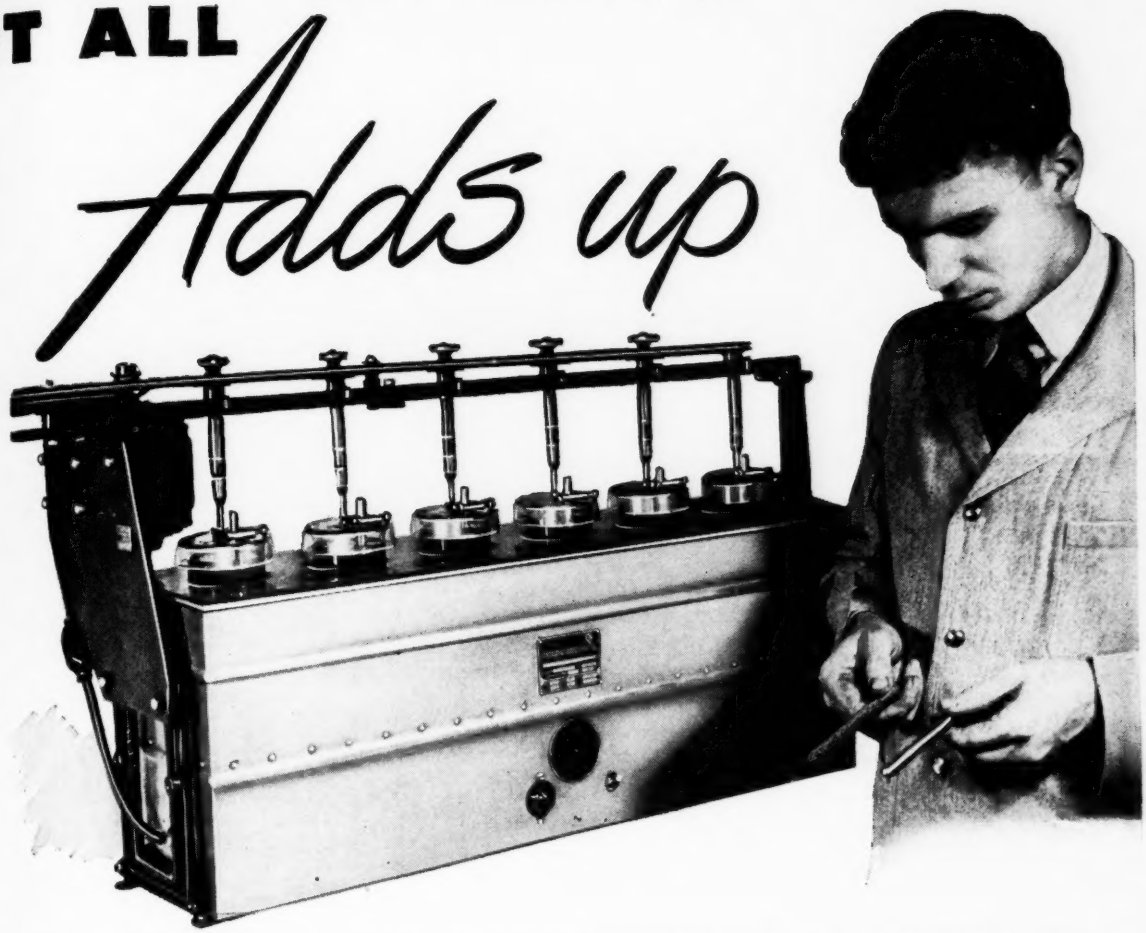
The Atomic Story. By John W. Campbell. First edition. 297 pages, 5½ by 8½ in. cloth. Illustrated. Published by Henry Holt and Company, Inc., New York, N. Y., 1947. Price $3.00.

This is by far the best book on atomic energy thus far published. It presupposes no knowledge whatever of nuclear physics, yet, after reading it, one will know all that an ordinary person, not a physicist, can know of the subject of atomic energy. Clear, simple, intensely interesting, the book takes the reader through every phase of the development of atomic energy from start to finish.

Since the atmoic bombs were dropped on Hiroshima and Nagasaki, a little over two years ago, some dozens of popular books have appeared, all attempting to give the lay reader an idea of what atomic energy is—how it was developed. Many of these are good, some of them excellent, but none of them tell the whole story in the way this book by Mr. Campbell does.

There is good reason for this, namely,

IT ALL *Adds up*



Where special qualities are essential for safe, enduring industrial lubrication, Sinclair Research develops additives that will "further improve the best".

Pictured above is one apparatus used by Sinclair Research to determine the rust-inhibiting efficiency of oils manufactured for turbine use. Chemical additives are studied to provide such protection against rust. Obviously, the treated oil sample used on the metal rod in the technician's left hand has high rust-inhibiting efficiency and prevented the deposit shown on the other rod.

All Sinclair Research and Refinery Control is similarly thorough. *It all adds up* . . . to assure you of lubricant qualities essential to efficient and economical industrial maintenance in all applications.

Sinclair Power Plant Lubricants
FOR MINIMUM FRICTION—MAXIMUM POWER

For Turbines:
SINTURLITE OILS

For Steam Cylinders:
SINCLAIR STEAM CYLINDER AND VALVE OILS

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RUBILENE OILS

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Lubricants for Industry

FINEST CRUDES + EXPERT RESEARCH and MANUFACTURING CONTROL = OUTSTANDING PERFORMANCE

the author himself. It is by no mere streak of fate that he turned out such an interesting book. First, he knows his subject; he has always been interested in science; in college he majored in physics with emphasis on atomic physics. Secondly, he knows how to write. He is the editor of a science fiction magazine and believes that truth is not only stranger than fiction but that fiction has difficulty in catching up with it.

The Atomic Story is just what its name implies; it is a story, not a treatise. It begins with the once upon a time when Democritus proposed the atomic theory. From there on, it carries you through the entire development of the concept of nuclear energy. It gives you the historical background against which to project the details of the atomic bomb development later on. It tells you about the instruments involved, how they work and how they are used. It gives the clearest explanation of a cyclotron that you will find anywhere.

Nuclear physics, says Mr. Campbell, is far simpler than the game of bridge in its broad basic principles. It takes a lifetime to become a top rank nuclear physicist, but it takes a lifetime of playing to become a bridge master too. Campbell believes that physics is a perfectly natural and simple thing and his book with its humor and crystal-clear approach, makes the understanding of the atomic story easy for the reader.

You don't have to be an engineer to understand this book, but if you are, so much the better—you will be able to appreciate it even more than the average reader.

You may have read a dozen books on atomic energy. You may have read all the articles published in this magazine on the subject during the past two years, but no matter, you should still read this book. Even if it deals with aspects of the subject you are already familiar with, you will find Mr. Campbell's account fascinating and more than worth while. Strangely enough, in an editorial in the June, 1938 issue of Astounding Science Fiction, Mr. Campbell said, "You can be fairly certain of this: **the discoverer of the secret of atomic power is alive on earth today.** His papers and researches are appearing regularly; his name is known. But the exact handling of the principles he's discovered —not even he knows how. We don't know which is his name. **But we know him. He's here today.**

The bold type appeared in the original editorial in June, 1938. Six months later Hahn and Strassman's discovery of the fission of uranium was announced.

Output and Productivity in the Electric and Gas Utilities 1899-1942, by Jacob Martin Gould; copyright 1946; size 6 by 9 inches; 195 pages; hard cloth binding; published by National Bureau of Economic Research, Inc., 1819 Broadway, New York 23, New York; price $3.00.

In presenting this, the tenth report dealing with the production, employment, and productivity in American industry since the beginning of the twentieth century, the National Bureau of Economic Research, Inc., has followed strictly its object to ascertain and to present to the public important economic facts and their interpretation in a scientific and impartial manner. The study upon which this volume is based was made possible by funds granted by the Maurice and Laura Falk Foundation of Pittsburgh. The book is divided into three parts, part I dealing with Electric Light and Power with two chapters, one on output and the other the relation of output to input. Part II deals with the manufactured and natural gas, likewise, divided into two chapters, one dealing with output and the other the relation of output to input. Part III is a summary which treats of the electric and gas industries, trends and contrasts. The book closes with four lengthy appendixes, the first three dealing with the construction of indexes of gross output, of fuel input and of net output of electric and gas utilities. The fourth is devoted to use of logarithmic parabola to depict growth trends. The book is a type which engineers thoroughly appreciate for it is filled throughout with tables and charts, there being altogether 42 tables and 22 charts. The indexes compiled by Mr. Gould tell a good deal about the growth of the two utilities and add to the knowledge of industries in general. They contribute to the story of trends in American industry in which the National Bureau has been engaged for some years. The relative growth of electric and gas utilities reflects a shift to them of production formerly carried on in other industries or in the household; and an increase in the consumption of their services either at the expense of other, now less suitable services, or in the satisfaction of new demands. The book is essentially statistical but the author has used these statistics for interpretating the progress of the utilities thus giving a background against which one may judge the industries' ability to progress during times of stress and depression as well as in normal and good times.

Management Techniques for Foremen—Questions and Answers for All Supervisors, by Richard W. Wetherill; copyrighted 1946; 8½ by 11 in.; simulated leather, loose leaf, ring binding; published by National Foreman's Institute, Inc., Deep River, Connecticut. Price $7.50.

This is a manual of instructions for men who have the responsibility of directing others in their work. The book has gathered together in it a large number of articles dealing with subjects which proved of interest to foremen and is arranged in sections which may be referred to readily. The author does not claim that the manual is complete, not every foreman

Here's How

ADVERTISING

by selling more goods to more people

MAKES YOUR JOB MORE SECURE

NO matter what your job today, it depends on "good business." And someone has said that in the American business system, nothing can be accomplished until "something is sold."

You know the truth of this. Falling sales mean pay cuts, layoffs, fear. Increased sales mean better pay, promotions, more security in every job for every man.

Advertising is the low-cost, efficient way to sell goods. Advertising is the spark plug of business. So advertising, by selling goods, makes your job, your home, your income more secure!

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1. Brings you better goods for less money.
2. Makes shopping more pleasant and easier.
3. Has given us the world's highest standard of living.

Power Plant Engineering

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help produce and THESE PRODUCTS...

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Alkalies
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C—Canned Goods
Cement
Chemicals
Citrus Products
Coal
Conduit
Cotton
Cotton Oil
Copper
Cork Products
Corn Products

D—Dairy Products

E—Electrical Equipment

F—Farm Implements
Fencing
Files Fuel Oil
Flour Furniture

G—Gas Glass
Gasoline Greases
Gypsum Product.

I—Iron

L—Lubricating Oils

M—Magnesium
Malt Products
Munitions
Musical Instruments

O—Oil
Oil field equipment

P—Paint Pigments
Paper Pulp
Pharmaceuticals

R—Railway Equipment
Records
Rum

S—Salt Sugar
Steel Superchargers

T—Textiles Tires

W—Welding Materials
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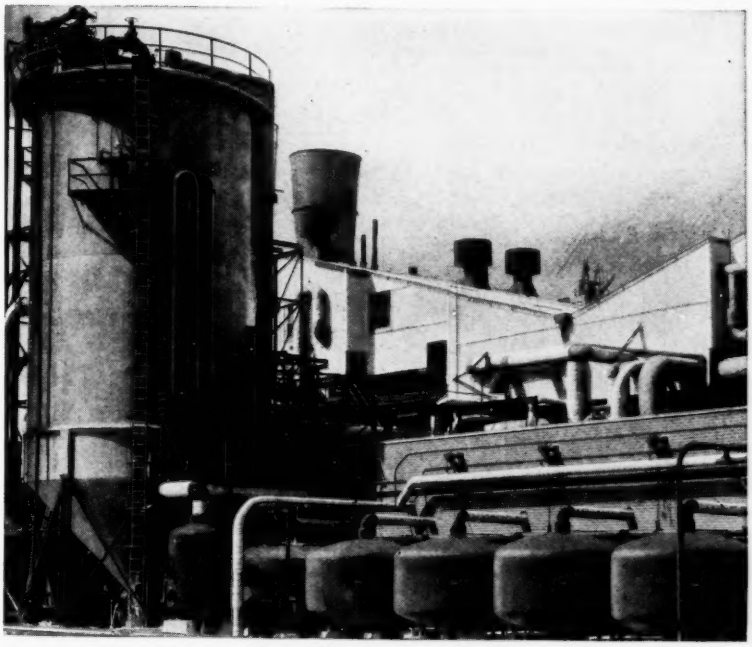
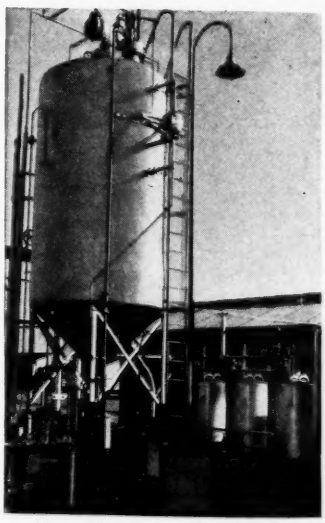
Exclusive features make possible continuous, trouble-free boiler operation.



for the large plant



for the small plant

for the medium-size plant

Wouldn't you like to know what a Hot-Flow Softener can do for you in your plant? One of our engineers will be glad to call on request. INFILCO Inc., 325 West 25th Place, Chicago 16, Illinois.

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IF YOU WANT TO KNOW — ASK INFILCO

will have responsibilities for which it covers, however, some will have more but material in these pages is based on many training sessions conducted by or under the direction of the author. The section headings included are as follows: responsibilities, information, lining up a job, introducing people, training, safety, quality, cost, quantity, physical property, working conditions, managing people, rate problems, labor relations, discipline, leadership, co-operation and advancement. The book is full of short, concise paragraphs giving the principles which have been found successful in the management of workmen and if you are foreman or engineer managing the activities of a group of workers you will find this manual extremely helpful to you in the handling of men and their work.

Applied Atomic Power, by Edward S. C. Smith, A. H. Fox, R. Tom Sawyer, and H. R. Austin; copyrighted 1946; size 6 by 9 in. 227 pages; hard cloth binding; published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, New York. Price $4.00

In this book the authors have done a creditable job in explaining what atomic power is and then in discussing how that power may be applied to our every day needs and purposes. It is written in relatively simple language and divided into five parts. The first describes the mineral uranium, its geological distribution and physical characteristics. In the second section atom splitting—the phenomena of fission—is explained and also how it produces atomic energy. In the third part, the book gives a summary of the developments of atomic energy and explains the problems that are encountered in the production of plutonium. The possible methods of converting atomic energy into mechanical power are treated in the fourth section which is the most valuable portion of the book as it illustrates some of the ways in which the products of atomic energy may be utilized in existing machines and the possibilities of developing plentiful power for peaceful purposes. The book closes with a summary of industrial benefits from the extensive research that preceded the production of materials and some valuable appendices. Those who are not in the very inner circle of research activity during the period of the development of atomic fissions will appreciate this recent book which puts in the most simple language possible the theory back of atomic fission and an outline of the history of the development of this most recent scientific discovery. The reader of this book will find it not only informative but stimulating and helpful in fixing in the mind the theories back of atomic fission which have proven to be the correct ones to apply in the generation of atomic energy.

60 Years with Man and Machines, by Fred H. Colvin in collaboration with D. J. Duffin. copyright 1947 first edition; 6 by 9 in.; 297 pages, fully indexed; hard cloth binding; published by Whittlesey House, McGraw-Hill Book Co., New York, N. Y. Price $3.50.

Although this book is called an autobiography, it differs from the usual autobiography in that it stresses the author's observations of his personal contact with the development of machinery and industry and the men responsible for that development, rather than a narration of his own accomplishments. It is full of anecdotes, some amusing, some tragic, but all interesting to the person who likes machinery and has a vision of its past, present, and future importance to the welfare of humanity. Mr. Calvin begins his narrative with his apprenticeship in 1884 and carries his observations through to the present time. He has participated in the development of the bicycle, the automobile, the aeroplane and the modern railroad locomotive as well as hundreds of new machines and machine tools. He has known intimately many of the great inventors, scientists, engineers, and industrialists and has witnessed the growth of many of our national scientific and industrial societies. Beginning with a word by Senator Ralph K. Flanders the book is then divided into 12 chapters the headings of which are entitled: The Machine That Can Reproduce Itself, In the Beginning Was the Belt Drive, Giving the Machine a Voice, A Society Sponsors the Machine, High-Wheelers and High Iron, Natural History of the Automobile, I Join the American Machinist, From Maxim to the Jet Plane, Machine Tools and the First World War, Tour of the World in Eighty Days, Machine Tools and Global Warfare, Past, Present and Future. The following paragraph written by Senator Flanders truly characterizes the author and the importance of his biography to the men in industry: "Fred Calvin occupies an unique position in the machine-tool industry. He has seen in his lifetime the transformation of that industry from an accessory of industrial development to firm establishment as its foundation. He has watched the development of the machine tool from a simple means of getting useful things done to the point where it embodies in its design and operation the transfer of the skill of the exceptional mechanic and engineer, in usable form, into the hands of thousands and millions of operatives. It is this function of the transfer of skill that has made our nation supreme among the nations of the world in industrial might." This book is almost an outline of the history of machine development over the past 50 years and is told in a very interesting narrative form which is sure to be enjoyed by engineers and machinists who read it.

Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

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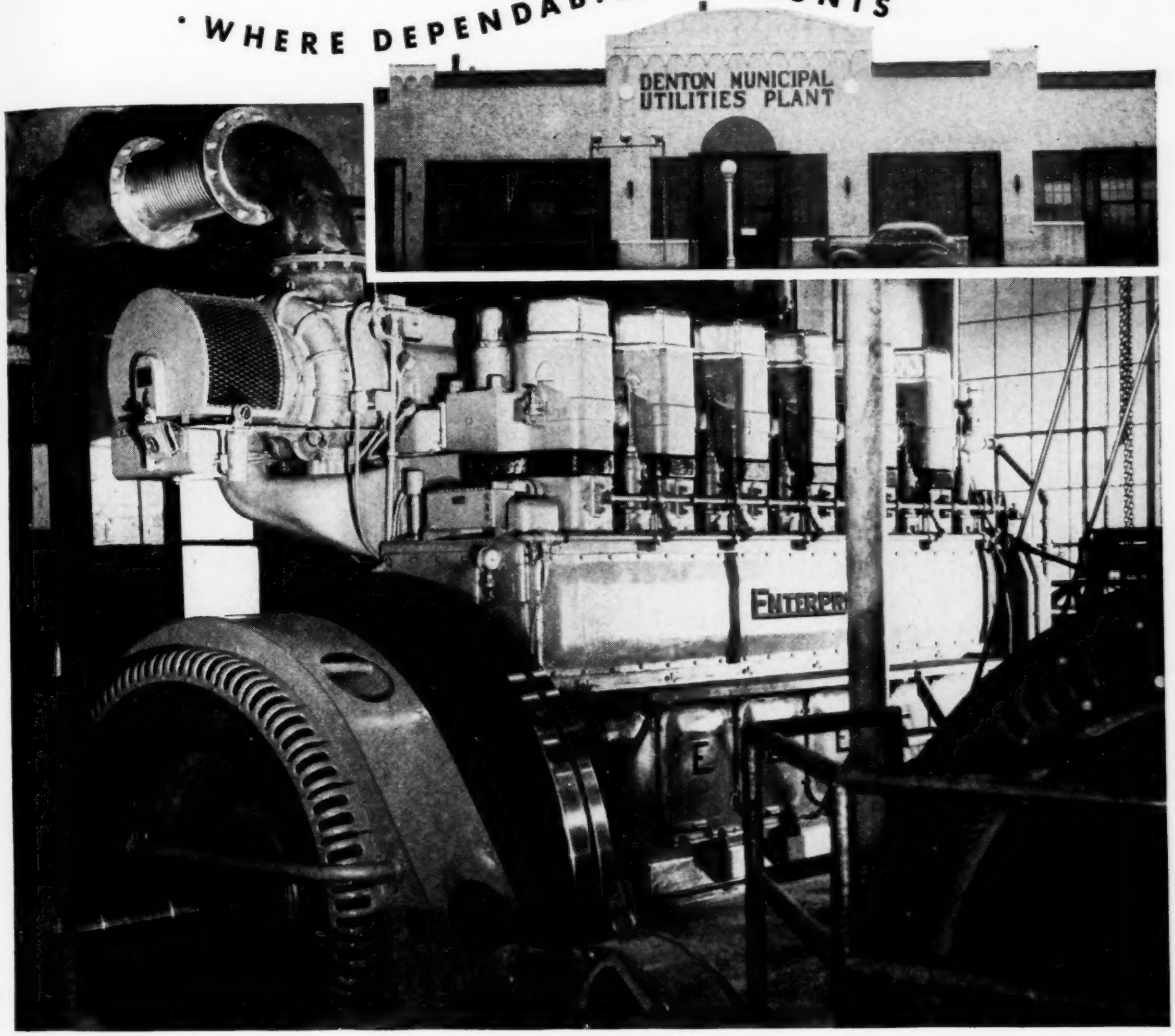
WHERE DEPENDABILITY COUNTS



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For Example, Denton, Texas—

. . . with its stable population of 20,000 swelled by another 10,000 in its two large colleges, has relied on Diesel power since 1928 for its complete electric light and power requirements. Less than a year ago, after 18 years of operation with up to eight engines of various other types, Denton installed its first Enterprise Diesel. Of great interest and importance to Denton municipal power officials is the fact that this Buchi supercharged Enterprise Diesel Model 800KW, 6 cylinder 16" x 20", rated 1200 HP at 327 RPM, is about one-third the size of any one of the other units previously installed, yet has approximately 20% greater power output! Found to be way out front in dependability, efficiency and economical operation during its rugged trial period of service, this Enterprise Diesel set the pace for greatly improved power for Denton: *Another* Enterprise Diesel has recently been installed. This is an 1142 KW, 8 cylinder 16" x 20" supercharged engine, rated 1600 HP at 327 RPM.

Plan now to investigate the proven worth of Enterprise Diesels for your particular requirements. Our experienced staff of Enterprise Engineers stands ready to accurately analyze your specific problems, to appraise your needs and to recommend units and accessories for unexcelled power service.

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HELPFUL BULLETINS

(Continued from page 35)

work of at least 10 gate valves ordinarily required to control a 3-filter battery. Line diagrams of the valve connected to the filters are presented in both plan and elevation views and installation photographs also are shown. Suggested specifications for externnal operating, piping, valves and headers are given. American Water Softener Co.

40 **Metal Hose Booklet**—Catalog No. 100, 12 pages, describes the company's line of flexible metal hose. Six different types of hose are shown and the text of the booklet presents such data as ordering information, tables of test results and descriptions of fittings for the hose. Atlantic Metal Hose Co.

41 **Engineering Data Book**—Engineering data and reference tables, described as a compendium of handy information for calculations on piping, pumps, heaters, traps, reducing valves, temperature regulators, pump governors, pressure controllers and other plant equipment, are contained in Bulletin 467 a recently-issued 12-page booklet. The tables are rendered more readable by the liberal use of color which sets off certain sections of the material. Leslie Co.

42 **Steam Traps**—Catalog 444, 28 pages, describes the company's line of industrial steam traps and steam, air and gas separators. The booklet is completely indexed and contains price lists of all items. The information is complete and compact with line drawings and photographs of the various numbers in the line accompanying the descriptions and the tabular dimensions and price lists. Outstanding and optional features of the units are explained and operation is completely discussed. Recommended piping diagrams comprise some of the most useful information in the well made-up booklet. W. H. Nicholson & Co.

TREATMENTS

43 **Soot & Sludge Remover** — Bulletin E-57 describes a soot and sludge remover which is said to be a liquid fuel oil treatment which cleans fuel systems from storage tank to burner types. The bulletin describes the advantages of the material and shows photographs and the tests conducted with fuel oil which has not been treated and then continues the series with photographs showing the results when the sludge remover had been added. Elraco Engineering Co.

44 **Information on pH**—This is a small 12-page booklet, Bulletin 92A, which describes in non-technical terms the meaning of pH. It tells just what is meant by the term, reproduces the pH scale which shows increasing acidity and increasing alkalinity and goes on to tell how it is measured and how modern pH control is used. But a very small part of the bulletin is devoted to a description of the company's pH measuring equipment. National Technical Laboratories.

45 **Process Liquids**—Bulletin 12, issued recently is titled "Treatment of Process Liquids." This is a 4-page bulletin and discusses the use of ion exchangers in purification of various process liquids. A typical multiple demineralizing plant is shown in a large drawing and a brief description and some of the applications of the ion exchanger are listed. Liquid Conditioning Corp.

46 **Water Conditioning** — The essential function of a hot process water conditioning system is explained and diagramed in a new 12-page Bulletin 28B6611. Included is a description of the equipment and an explanation of what it is designed to do together with the mechanism of its operation. The bulletin tells of the system's reaction and sedimentation tank, raw water inlet regulating valve, spray heater, vent condenser, vacuum breaker, recording thermometer and chemical feeding equipment. It also discusses condensate and treated water storage. Allis-Chalmers Mfg. Co.

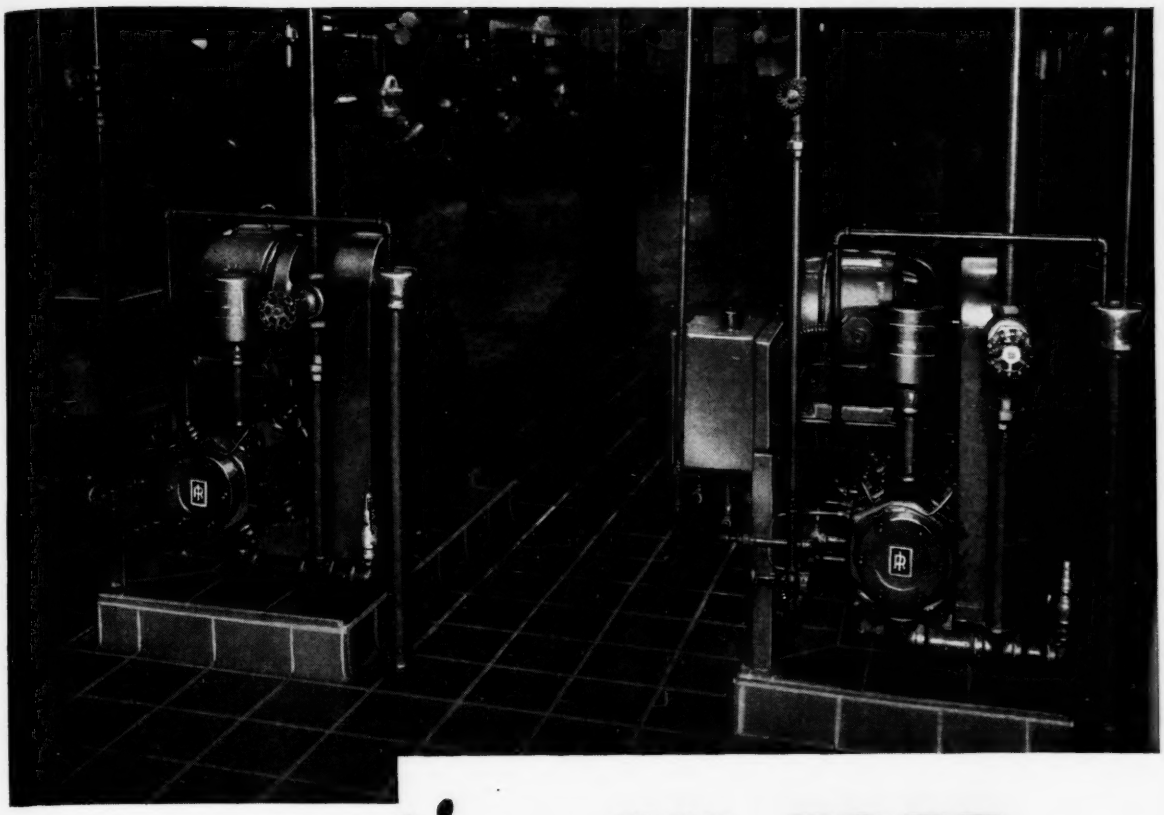
MISCELLANEOUS

47 **Power Plant Profits** — "Dividends from Your Power Plant," is the title of this booklet; it contains 36 pages and is bound in a separate heavy paper cover. The various chapter headings will give a clue to the contents; some of these are: "Good" Boilers can Waste Money, The Engineer is a Gold Mine; The Ideal Boiler of Moderate Size; If Steam Were a Raw Material; If the Production Budget has a Close Margin. The text is emphasized by carefully selected tables and line drawings. Preferred Utilities Co., Inc.

48 **Choosing Tanks**—There are 78 pages in this loose-leaf booklet which is devoted entirely to the subject of "The Choosing and Using of Tanks," both wooden and steel. Excellent photographs are presented in the booklet and the description which accompanies each illustration is brief and pertinent. The "why" of all the statements made is thoroughly discussed and points are brought out by line drawings and before and after photographs. The booklet is largely concerned with oil storage tanks. Black, Sivalls & Bryson, Inc.

49 **Engineering Service**—This company has issued a 24-page booklet describing its complete engineering and design service. As the booklet points out, the company is staffed to create industrial designs and to provide engineers, draftsmen, illustrators, creators and stylists for various products. Among the services shown are developments in industrial, process, electrical, products and structural engineering and plant layout and tool design. Views of the various offices maintained by the company are shown and case histories of jobs which have been handled are explained. Design Service Co.

50 **Diesel Electric Sets**—Form 9895 is a recently issued bulletin which tells about the many and varied applications of Diesel electric sets; it is titled "Why Owners Like Caterpillar Diesel Electric Sets." The booklet describes the reasons for the applications which are outlined. Fields covered include construction, manufacturing, hatchery and business. The booklet is exceptionally well illustrated. Caterpillar Tractor Co.



Generating OIL-FREE AIR POWER

These two 7½-hp Type ER-NL compressors are generating *oil-free* Air Power for an instrument-control system in a central power station. They're standard heavy-duty compressors equipped with NL (non-lubricated) cylinders, overhead-motor drive, and dual control for selecting either constant-speed or automatic stop-and-start regulation.

The pistons of Ingersoll-Rand non-lubricated cylinders have graphitic-carbon wearing rings and pressure rings which prevent metallic contact. No lubricant is needed in the cylinder.

NL cylinders are available for Ingersoll-Rand heavy-duty compressors, single or multi-stage, for belt, electric, steam, oil, or gas-engine drive.

For spraying enamels... or for conditions where the air comes in direct contact with foods or chemicals that must not be contaminated by any trace of oil... or for instrument-control systems... select an Ingersoll-Rand NL compressor.

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CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 **Steam Generators**—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, municipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 **Double-Pass Boilers**—Bulletin R-M-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned line diagrams; 8 pages. The Brownell Co.

53 **Boilers, Burners, Accessories**—Bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.

54 **Standardized Boilers**—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 **Steam Generators**—Presents reasons for high efficiency; shows brief case histories of plants. Results of tests by independent authorities and "Facts You Should Know About Steam Generating Unit." Ratings, dimensions and other data presented. Springfield Boiler Co.

56 **Steam Generator**—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes are given. Union Iron Works.

What...NO WEEKLY CLEANING?

Weekly tube cleaning went out with horse-drawn cars and mustache cups. Today's boiler designs and feedwater treatment have improved greatly. Tubes don't scale up as fast. But when scale *does* accumulate, it presents a bigger problem than ever before—bigger because boiler temperatures and pressures are higher—tube failures can be more disastrous. Bigger, too, because boiler down-time and repair-time are increasingly expensive in view of today's rising costs.

That's why fast acting Wilson Tube Cleaners are found in more and more modern boiler plants. The Wilson ECT Series Air Motor, for instance, develops up to 40% more power when "taking the curves", permitting substantial reductions in cleaning time. This motor, together with the patented Wilson Expanding Brush, will remove the light powdery deposits found in today's boilers *faster* and *more thoroughly* than any other cleaner. When heavier deposits are found, speedy non-tracking Wilson Cutter Heads are available.

Every modern boiler plant should have fast Wilson Tube Cleaners in the tool room. Why not write for Bulletin 47 describing the more generally used Wilson Cleaners, or see your local Wilson Representative?

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WILSON
TUBE CLEANERS

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PRIME MOVERS

57 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. The Terry Steam Turbine Co.

58 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

59 **Turbines, Pumps, Products**—This 24-page catalog covers the company's complete line of products from steam turbines to flexible couplings. Every product is discussed from the design and operation angles and the discussion is heightened in interest by the inclusion of many excellent photographs. Other products discussed are helical gears, centrifugal pumps, multistage pumps, screw pumps, blowers, compressors and speed reducers. De Laval Steam Turbine Co.

60 **Turbine Cleaning Manual**—This 20-page bulletin covers the step-by-step solvent and manual cleaning of turbines from the inspection and preliminary cleaning to draining and final inspection. The cleaning of bearings and governor, installation of filter unit, circulation of cleaning solvent, and displacement of cleaning oil with new lubricating oil are steps which are covered briefly but clearly. Shell Oil Company, Inc.

61 **Steam Engines**—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

62 **Generating Sets**—Bulletin No. 108; General description, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

63 **Stationary Diesel Engines**—Dependability, adaptability of Diesel power described and applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

ELECTRICAL

64 **Oil Circuit Breaker**—Bulletin 71B-6421 describes Unitop oil circuit breaker; ratings from 15 to 46 kv. 500,000 to 1,500,000 kva interrupting capacity. Well illustrated. Allis-Chalmers Mfg Co.

65 **Generating, Substation Equipment**—Bulletin 25B6150 titled "More Power to U.S.A." 32 pages; sketches coverage of the company's equipment from hydro and steam turbines to switchgear and circuit breakers. Unusually well illustrated. Allis-Chalmers Mfg. Co.

AUXILIARIES, ACCESSORIES

66 **Strainers and Separators**—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

67 **Atomizing Deaerators**—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

68 **Condensate Return System**—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installation pictured and described. Drawings and text show proven results from

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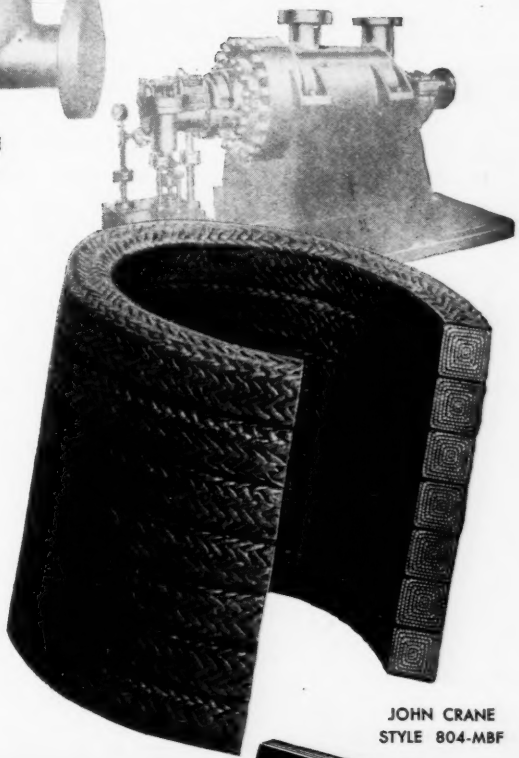

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experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

69 **Low Pressure Evaporators**—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L. P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

70 **Power and Industrial Equipment**—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbo-chargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

71 **Heat Exchanger**—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

72 **Evaporators**—Bulletin 364 describes, illustrates exporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained by their use; different types of evaporating systems and their association with plant balance. 26 pages. The Griscom-Russell Co.

73 **Soot Blowers**—Bulletin F45; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations indicated thereon and installation drawings and data are included; 10 pages. Marion Machine, Foundry & Supply Co.

74 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

75 **HP Extraction Heater**—Bulletin M-302 describes and illustrates the company's patented high pressures closure, Multilok. The features and advantages of the closure as compared to other types of construction are fully described in this 8 page bulletin. The Lummus Co.

76 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

77 **Rack and Pinion Gates for Coal and Ashes**—Ball-bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

78 **Steam Specialties**—Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and units list prices; descriptions; illustrations; tables of capacities. The C. E. Squires Co.

79 **Deaeration**—Data book; No. N-15 gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Co.

80 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities, corrosive service; 42 pages. The V. D. Anderson Co.

WATER TREATMENT

81 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

82 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

83 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

84 **Water Conditioning Service**—"The 6 Fundamentals of Betz Water Conditioning Service" illustrates and describes how this company extends a supervisory service for boiler water conditioning. Booklet shows complete operation of these 6 steps; 16 pages. W. H. & L. D. Betz.

85 **Water Softener**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

86 **Softener Handbook**—Manuel, semi and full-automatic zeolite water softeners are covered in Bulletin 315. Water softener plant is discussed in the first section and operating cycles and plant supervision is next considered. The third section is "Selecting Manual or Automatic Equipment"; this is accompanied by a table of comparison data. Graver Tank & Mfg. Co., Inc.

87 **Sludge Reactivator**—Illustrated booklet, 8 pages, fully explains the principle of upward sludge filtration and describes its adaptability to industrial and municipal water supplies. Charts, flow diagrams and cut-away drawings show clearly how equipment softens and clarifies raw water, materially reduces reaction time and provides, in many cases, a water that is suitable for process work without further treatment. Graver Tank & Mfg. Co., Inc.

88 **Hot Process Water Treatment**—Form 326 is a case study bulletin; covers results of an installation of the company's hot process equipment at Kankakee Ordnance Plant. System was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. Graver Tank & Mfg. Co., Inc.

89 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Products, Inc.

90 **Industrial Water Treatment**—Microbiological Control of and Through

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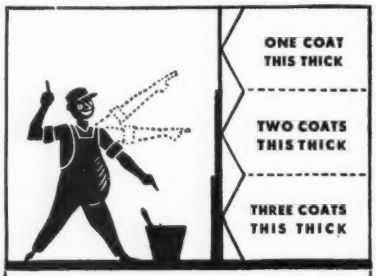

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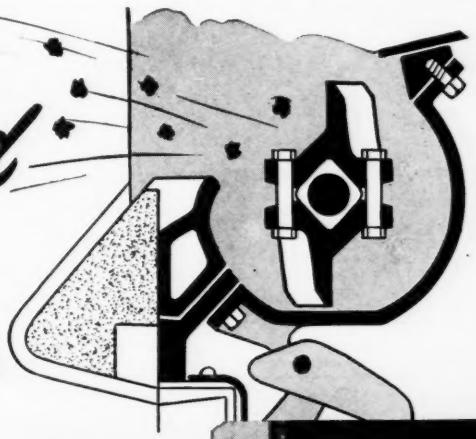

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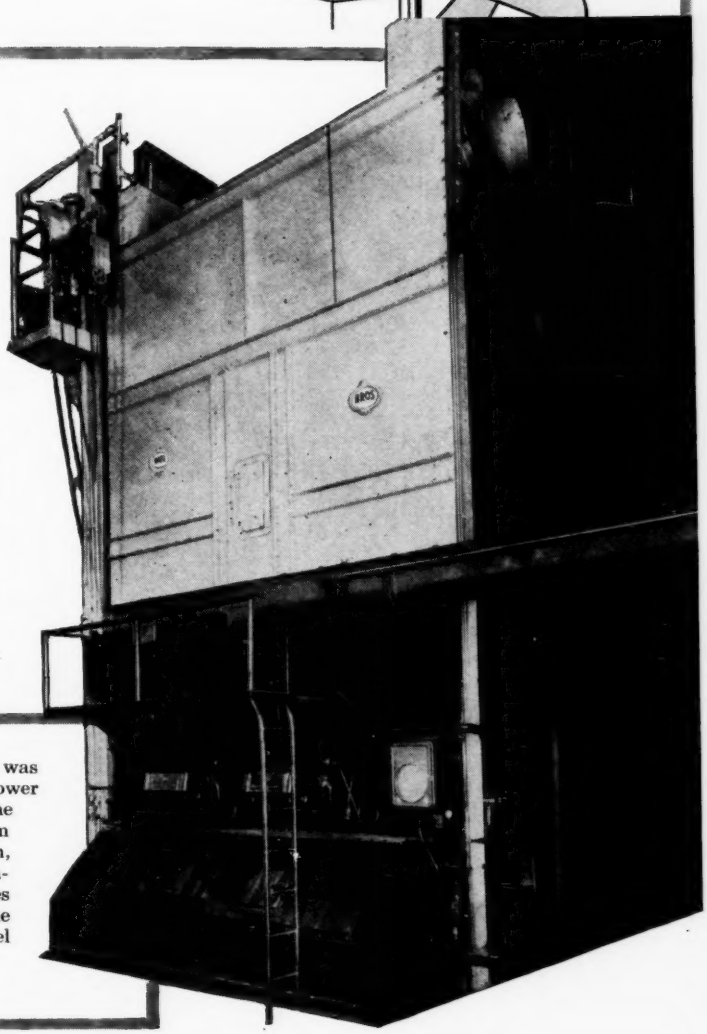

The Travl-Spred Stoker at the right was recently installed in the municipal power plant at Springfield, Minnesota. The installation includes a *Bros* 3-drum watertube boiler with 35,000 lb. steam, 450 lb. pressure, 750° total steam temperature. The Travl-Spred Stoker uses 14'9" shaft center, two 4' sections in the grate and incorporates two *Bros* Model 24 spreader type stokers.

BROS *Travl-Spred* **STOKER**

WM. BROS BOILER AND MANUFACTURING COMPANY, MINNEAPOLIS 14, MINNESOTA

Industrial Waters; spot summaries of improvement of process efficiency and product quality of proper sterilization. Wallace and Tiernan Products, Inc.

91 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important consideration in chemical treatment of cooling water circuits. Wallace & Tiernan Products, Inc.

92 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Products, Inc.

93 **Clarifying and Softening Water**—Eight-page catalog "Reactivator for Clarifying and Softening Water by Upward Sludge Filtration." First part of the booklet tells how the reactivator works and how the sludge blanket is kept in control so as not to flow out with the clarified water. Line diagrams illustrate the principle of operation. Graver Tank & Mfg. Co., Inc.

94 **Feed Water Treatment**—This four-page folder tells how the company's engineering applied to boiler feed water problems can result in savings. It tells of the different procedures and presents diagrams of equipment arrangement. Typical installations in dairy, cosmetic, aircraft, laundry, and other plants are pictured. Illinois Water Treatment Co.

95 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

96 **Automatic Proportioning**—Bulletin 1200, 28 pages. Handy reference book containing wealth of information on automatic flow responsive equipment and methods in continuous process operation. Photos of equipment and installation are supplemented by many flow diagrams and detail drawings. Complicated subject made exceptionally clear and understandable by careful arrangement and two-color diagrams. Proportioneers, Inc.

97 **Chemical Proportioning Equipment**—Bulletin 1714 covers chemical proportioning equipment for sea-going service. Two units—for high or low pressure—are described fully. Tabular material assists in the description. Proportioneers, Inc.

98 **Water Conditioning Instruction Booklet**—Bulletin 28X6385 was written especially for guidance of power plant operators. It touches upon importance of feedwater control, care of testing equipment, obtaining samples, test procedures. Handy reference tables given as aid to reporting results. Allis-Chalmers Mfg. Co.

99 **Complete Water Conditioning Service**—This four-page bulletin describes this company's complete water conditioning service—analysis, design fabrication, installation and maintenance of water treating equipment. Typical installations are pictured and brief sketches of the men behind the service are given. Graver Tank & Mfg. Co., Inc.

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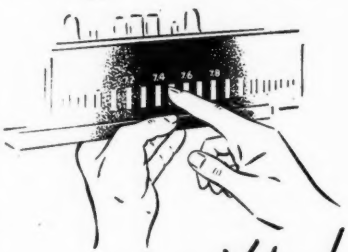

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COATINGS, TREATMENT

100 **Protective Coatings**—4 page folder 844-246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. Wailes Dove-Hermiston Corp.

101 **Fuel Oil Traatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge." Advantages of using the treatment such as stepping up efficiency and reducing operating costs are explained. A list of dosages and applications is also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

102 **Flue Cleaner**—The company's soot and fire scale removing compound is described in this six-page folder. Results obtained from the use of this compound are described in the first part of the folder and then a list of the things which the company guarantees the material will accomplish are listed. Tables of dosage are presented and another table shows losses due to soot and fire scale. Dominion Chemical Co., Inc.

103 **Boiler Rust Treatment**—This four-page bulletin describes the company's "Rustoff" chemical which is said to "build resistance to rust and scale corroded and congested pipes." The bulletin tells how the treatment works and what results may be expected from its use. A brief description of the company's service department is included. Dominion Chemical Co., Inc.

104 **Fuel Oil Treatment**—Several bulletins have recently been announced by this company describing completely the application and effect of its fuel oil treatment compound and Diesel engine solvents. Wilcolene Mfg. Co.

HEATING, COOLING

105 **Cooling, Heating, Air Conditioning**—Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data, numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc. Niagara Blower Co.

INSULATION

106 **Industrial Insulations**—Block, blanket insulations; pipe covering; new pressure coverings; insulating cement; felt; Koldboard; fill insulation; diatomaceous earth products; uses, specifications, applications, preparation; charts; photos; list prices; 26 pages. Baldwin-Hill Co.

107 **Insulating Cement**—Ease of application, efficiency; ease of maintenance application recommendations; heat loss calculations, 4 pages. Baldwin-Hill Co.

STOKERS

108 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 tables. American Engineering Co.

109 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

110 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

Reliance helps you to comply with latest safety regulations

New operating chain handles for gage valves give sure guide to valve position

Furnished on all future shipments from factory—available at nominal cost to present users.

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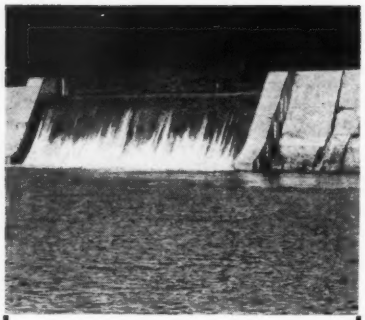

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111 **Pneumatic Spreader Stoker**—Threefold booklet on the inner pages of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

112 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

113 **Coal Reference Bulletin**—Bulletin 8, Underfeed Stoker Firing, Bulletin covers factors involved in selection of multiple retort stokers, principles, design data and drawings of typical installations; 6 pages. Fairmont Coal Bureau.

114 **Stoker Firing Operation**—Single Retort Underfeed Stoker Firing is the subject of Bulletin Number 9 issued by this Bureau. It is a complete analysis of the advantages of the single retort stoker in the smaller plants. Types of this stoker are described and principles of operation are outlined. Fairmont Coal Bureau.

OIL, GAS BURNERS

115 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control, drawings; 4 pages. Peabody Engineering Corp.

116 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

117 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross-sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

OIL, LUBRICATION

118 **Lubrication Recommendations**—Special oils for Diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

119 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; how to apply; metallic cutting tools; tabular material; shop practices; 50 pages. Standard Oil Company of California.

120 **Diesel Operation**—Relation of fuels and lubricants to the operating efficiency of the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

121 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

122 **Lubricants Service Handbook**—28 pages in this booklet on lubricants and their application. The development of the lubricant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions is given. Fiske Brothers Refining Co.

123 **Oil Products for Industry**—Cutting oil, processing oils, general lubricants, refrigeration oils, Diesel oils, solvents, greases and waxes are among the petroleum products for industry which are described in this four-page folder. The various grades of each oil are analyzed and the reasons why they are fitted to each particular job are given. Sun Oil Co.

124 **Lubricania**—The hundreds of specialized lubricants in use today are identified by certain commonly used tests and terms which describe their physical characteristics. In this dictionary of terms, tests and values, the company has highlighted the most important of these. Tide Water Associated Oil Co.

POWER TRANSMISSION

125 **Speed Reduction, Increase Gear**—Bulletin S-130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

126 **V-Belt Drive Guide**—Bulletin B6051F; guide to company's complete line of V-belt drives. Contents include types and sizes. V-belt prices, how to figure drives, belt selector charts and tables and similar engineering information. Well illustrated; 12 pages. Allis-Chalmers Mfg. Co.

127 **Flexible Couplings**—Bulletin 57; 2 pages of drawings and tables of rat-

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Increasing Condenser Tube Life Through Close Cooperation With Bridgeport Laboratory

The desirability of close cooperation between condenser tube users, builders of equipment, consultants and manufacturers of tubing is generally recognized. However, when trying to help the power plant operator obtain more satisfactory service and longer life from his condenser tubing we must work together and pool our experiences and information. The more information available the more satisfactory will be the outcome.

Information Required

Information about operation procedures, composition of the cooling water, temperatures, velocities of water and steam, pressures and other factors is necessary to determine the alloy which will give the longest life under existing conditions. If tubes are failing prematurely a change in operating conditions may be advisable.

Our laboratory is constantly receiving samples of tubing with the object of determining: (1) how condenser tube life can be increased and (2) to learn how certain alloys are standing up under varying conditions of service.

Importance of Proper Sampling

There are many reasons why it is desirable to use full length samples. The primary reason is that the extent of corrosion may vary considerably along the entire length of the tube. Examination of any one spot will not give a true picture. A minimum of two full length tubes should be carefully identified and removed from the condenser or heat exchanger. One tube should be taken from that portion which gives the most trouble and the other from that which gives the least. Otherwise, submit a sample of the worst and the best tube. It is important that the full length sample of tubing be clearly marked to indicate which is the top and bottom as the tubing was used. Also the inlet and outlet ends should be suitably identified. It is necessary to cut the tubing into sections for convenient mailing. We prefer about 2 ft. lengths, with each length numbered consecutively from the inlet end to outlet end so that the tubing may be accurately reassembled in our laboratory.

Pertinent Data

The following information should be furnished with samples properly taken and marked for identification. Most of the information required can be obtained from the records kept by the operating engineer.

1. Length of time sample tube has been in service.
2. History of tube performance in this condenser and adjacent ones.
3. Type of condenser.
4. Temperatures, velocities, and pressure.
5. Elevation of condenser in relation to intake.
6. Operating schedule.
7. Frequency of cleaning and type of debris found.
8. Evidence and nature of pollution, if any.
9. Location of condenser and nature of cooling water.
10. Composition of cooling water.

Water Analysis Important

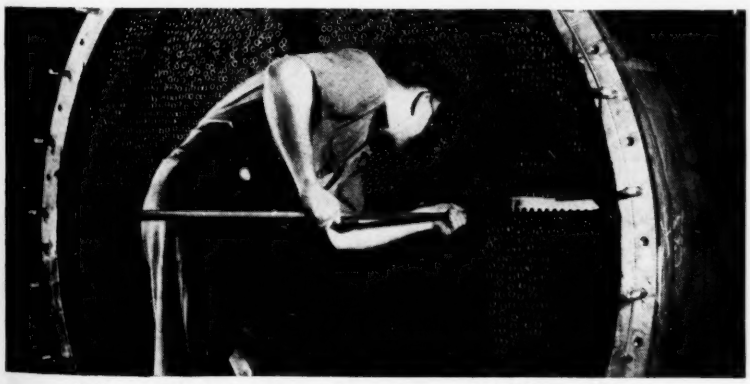
Experience has shown that the most difficult information to be obtained is a representative water analysis because of seasonal variations. This is further complicated by the fact that the presence of industrial wastes, sewerage, debris, etc. does not appear in the typical water analysis. It is therefore important to know the seasons when the samples for analysis were taken and something about the nature of the pollution, if any. It is well established that the composition of the cooling water has a most important bearing on condenser tube life.

Corrosion Data Available

Bridgeport is maintaining an extensive program of corrosion research, consisting of laboratory work, field and service tests. The purpose of this program is to help users get the most satisfactory service from their condenser and heat exchanger tubes. Our laboratory welcomes the opportunity of cooperating closely with power plant and marine engineers, condenser builders and consulting engineers. Our experience in the field of corrosion is available through the nearest Bridgeport office.

Condenser Tube Manual

Write for your copy of Bridgeport's 112-page Condenser Tube Manual containing up-to-date information about condenser tubes, methods of installing, and complete information about increasing condenser tube life.



Tubing an 8000 sq. ft. surface condenser. Courtesy: Allis-Chalmers Mfg. Co.

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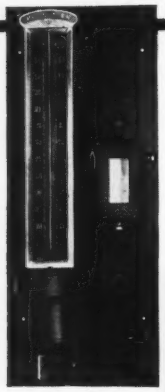

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155 **Temperature Regulators** — Bulletin 7-A; six types; descriptions; list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

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157 **Liquid Level Controllers** — Bulletin A-100 is a four-page catalog describing this company's Types G and D liquid level regulators. Excellent cross-sectional views of the units are presented and their operational and constructional features are described. Dimensions, capacities and shipping weights are presented. Stets Company.

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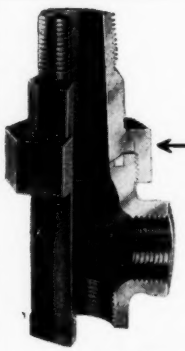

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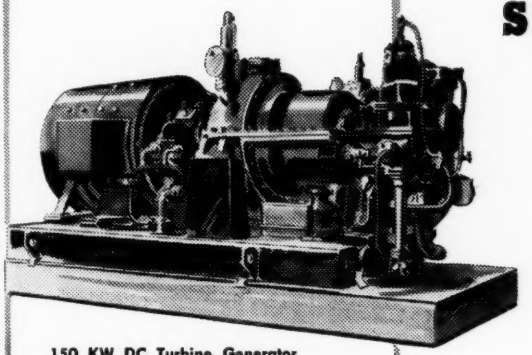

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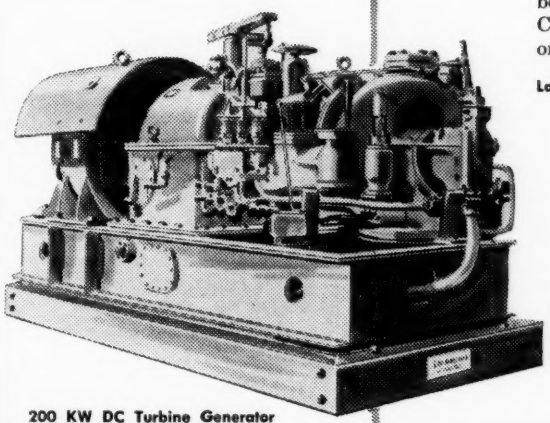

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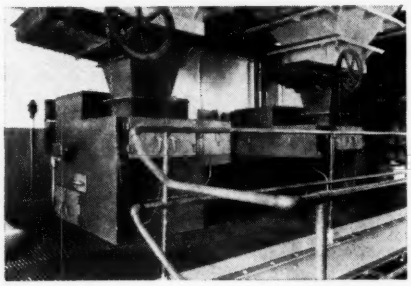

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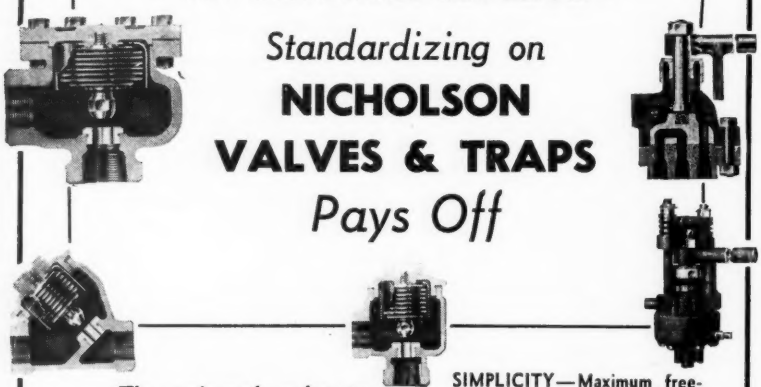

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letin 455. These four pages present photos and chart reproductions and tell the details of the company's control equipment on this particular type of boiler. Northern Equipment Co.

160 Water Level Control—Bulletin 459, 8 pages, description of water level control installation at Wyman-Gordon Co. Good illustrations show details of installation. Table of significant data given. Northern Equipment Co.

161 Boiler Water Level Control—Bulletin 467 and 465, 8 pages each, describe respectively, control installations at Buzzard Point Plant and West Reading Station. Both give exceptionally detailed reports of the installation complete with tables, photos and drawings. Northern Equipment Co.

PACKING GASKETS

162 Packing — Bulletin 237; photos and descriptions of use; installation drawings; standard size table; 4 pages. Warren Steam Pump Co., Inc.

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163 Standards for Flanged Fittings, Valves, Flanges—Pressure temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

164 Welding Fittings—Allowable working pressures; power, oil, district heating, refrigeration, gas and air piping; 14 tables and directions for use; 18 pages. Tube Turns, Inc.

165 Welding Fittings—Volumetric capacities, 2 pages of formulas for computation of capacities; 6 pages of tables; 12 pages in book. Tube Turns, Inc.

166 Unions—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

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167 Horizontal Duplex Piston Pumps—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawings, tables; 4 pages. Warren Steam Pump Co., Inc.

168 Steam Heat Vacuum Pumps—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

169 Centrifugal Pumps—Bulletin 302-30, Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

170 Hydraulic Pressure Pumps—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressure; 4 pages. Warren Steam Pump Co., Inc.

171 Screw Pumps — Recommended uses; advantages; tables of capacities and sizes; charts of test results; dimensioned drawings; suctions and discharge, packing box sizes, shipping weights tables; specifications; installation and maintenance; theoretical horsepowers; viscosity classifications; 18 pages. Sier-Bath Gear & Pump Co., Inc.

172 Centrifugal Pumps—Booklet describes basic action of centrifugal pumps, tells of the science of centrifugal action and the physics of pumping. Performance curves are presented. Descriptions of the company's self-priming centrifugal pumps are given and how they operate is explained. Typical use of the units are pointed out and installation and operation explained; 20 pages. Marlow Pumps.

173 Centrifugal Pumps—Bulletin 240, 6-page folder describing single stage, double suction, Type DBL centrifugal pump. Features of the pump resulting from its construction and engineering; a sectional view which is used to point out other advantages of the unit. Tables of metal specifications and capacity ratings in gallons are also given. Warren Steam Pump Co., Inc.

174 Multi-Stage Pumps—Bulletin 241 describes 4 and 6 stage Type TM pumps. Cross-sectional illustrations and tables of specifications are given. Dimensioned drawings and tables of dimensions accompany copy describing unit's construction and advantages. Warren Steam Pump Co., Inc.

175 Close-Coupled Pumps—Close-coupled pumps, called Compac-units, are described in Bulletin 242. This eight-page bulletin presents clear and understandable cross-sectional photos of the units and uses these to point out construction and operation features. A full-page "Composite Rating Table" presents rating information at various heads for 9 different models of pumps. Warren Steam Pump Co., Inc.

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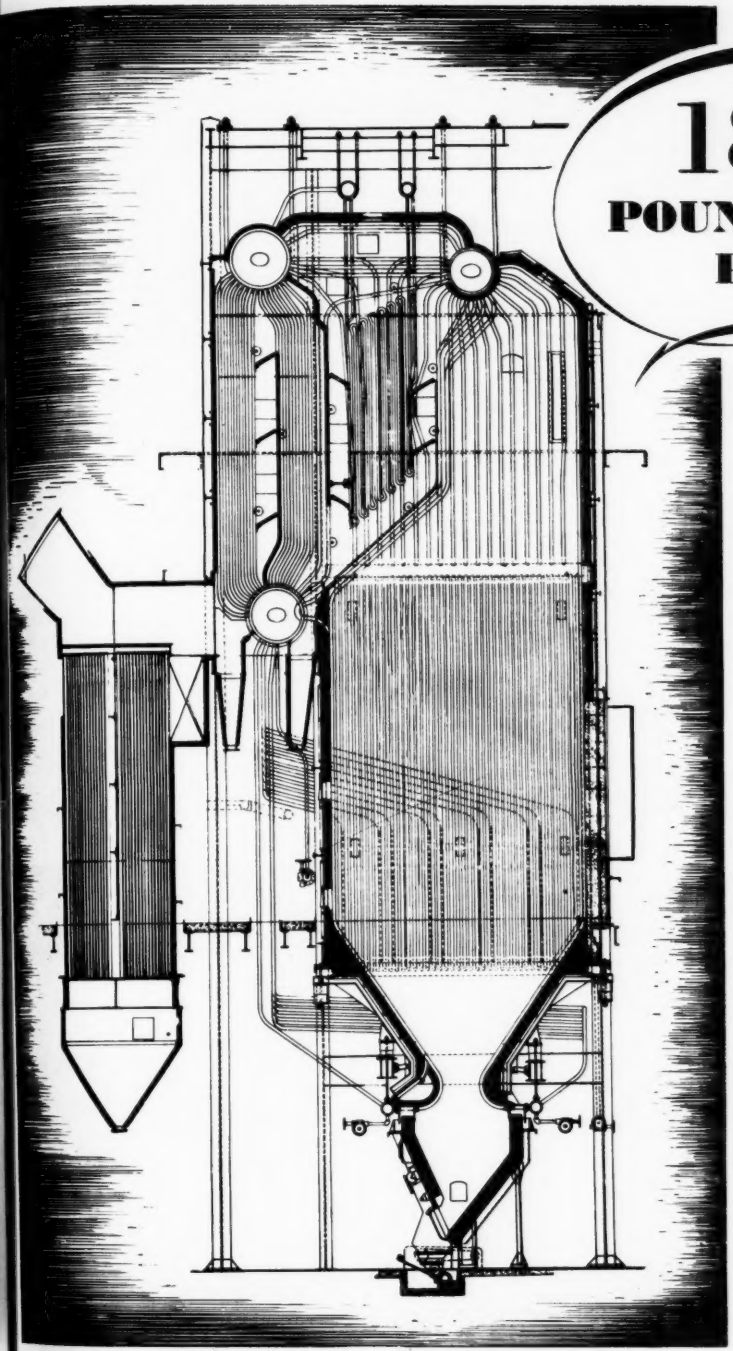

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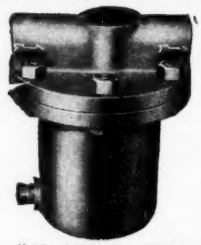

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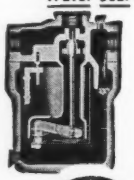

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MISCELLANEOUS

177 Floor Resurfacing — This recently-published folder describes the methods of use of the company's heavy-duty resurfacer for use on floors, traffic aisles and loading platforms. It contains a concise, clear description of the properties, methods of application and advantages of the resurfacer and is of interest to everyone who has problems in the maintenance and repair of concrete floors. Stonhard Company.

178 Electric Tools—Bulletin 464; covers complete line of portable electric tools for construction and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co.

179 Refractory Concrete—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Lumnite Division, Universal Atlas Cement Co.

180 Gas Purger for Refrigeration Systems —Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, advantages and complete illustrated material. 8 pages. Armstrong Machine Works.

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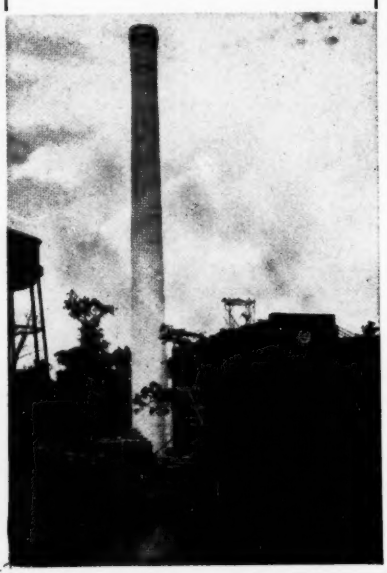

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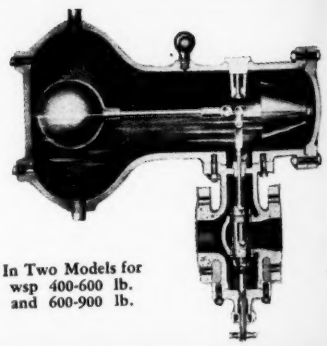

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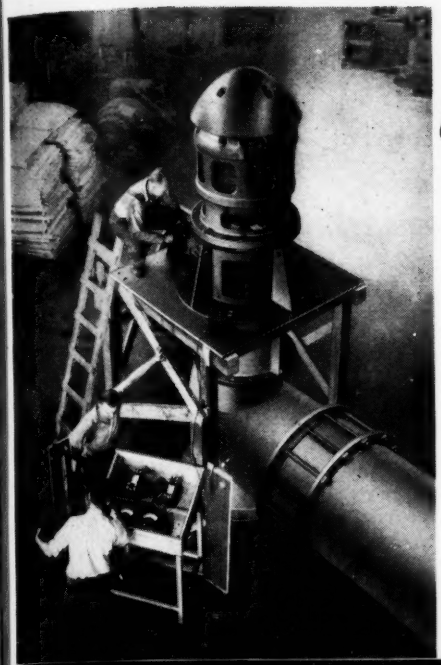

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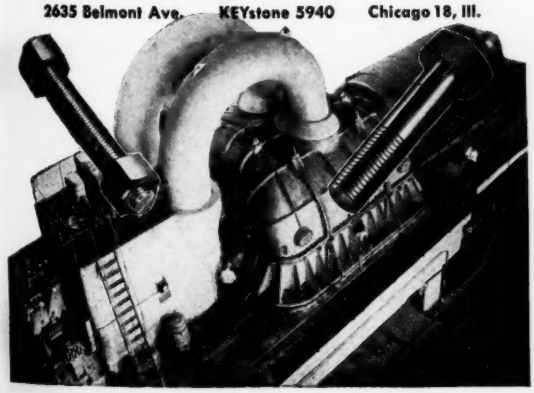

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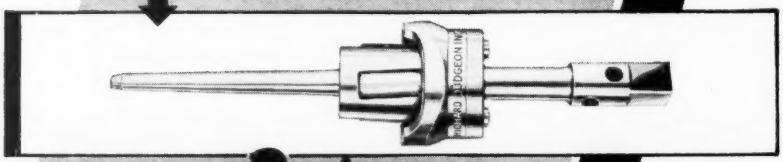

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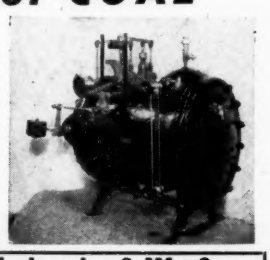

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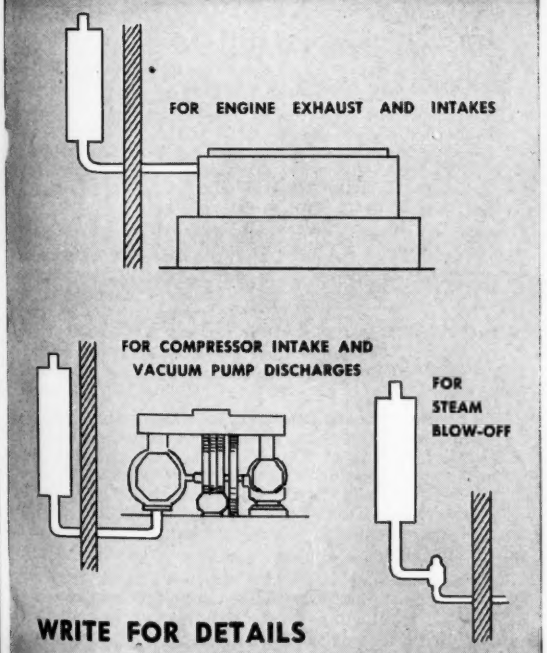

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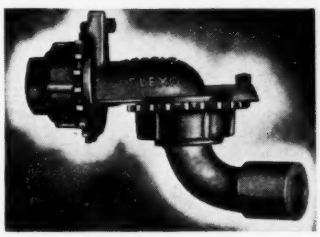

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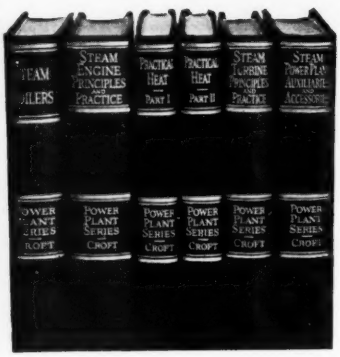
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POWER PLANT *Construction News*

Ala., Birmingham—Alabama Power Co., Birmingham, is considering extensions in hydroelectric generating station at Mitchell Dam, with installation of new hydraulic turbine-generator unit and accessories. Cost reported about $1,250,000. Company is also arranging fund of about $6,000,000 for new power substations, additions to present substations and transmission lines over period of about 36 months.

Calif., Los Angeles—Los Angeles Water & Power Dept., 311 South Spring St., has plans for new power substation at 11170 Nebraska Ave., West Los Angeles, to be known as Substation No. 28, 78 x 130 ft. Cost estimated about $225,000, with transformers, switchgear and auxiliary equipment. Work is scheduled to begin in near future.

Calif., San Bernardino—Pacific Paperboard Co., Longview, Wash., paper board, pulp board, boxes, etc., plans steam power house at proposed new mill on Marshall Blvd., San Bernardino, where site has been acquired. Plant will consist of three main one- and multi-story buildings, to be equipped for large capacity. Electric power equipment will be installed. Entire project will cost about $1,000,000. Work will be placed under way soon.

Ill., Chicago—Interlake Iron Corp., 332 South Michigan Ave., has filed plans for addition to boiler house at plant at 11236 South Torrence Ave., with installation of additional equipment for increased capacity. Cost reported over $75,000, with equipment. Freyn Engineering Co., 58 East Washington St., is consulting engineer.

Iowa, Greene—Town Council has plans under way for new municipal light and power plant, estimated to cost about $200,000, with electrical distributing system. Proposed to use Diesel engine-generating units and accessories. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, Iowa, is consulting engineer.

La., St. Landry—Central Louisiana Electric Co., Alexandria, La., will proceed with superstructure for new steam-electric generating station in vicinity of St. Landry, with installation to include a 15,000-kw turbine-generator, high-pressure boiler and auxiliary equipment. Entire project is reported to cost approximately $3,000,000, with power substation and switching station, and transmission lines.

Mich., Grand Rapids—National Brass Co., 1601 Madison St., N. E., has plans in progress for new boiler house at plant. Estimates of cost are being made. Proposed to begin work in near future. Harry L. Mead, Michigan Trust Bldg., Grand Rapids, is architect.

Mich., Iron Mountain—Wisconsin-Michigan Power Co., 137 West Mill St., Appleton, Wis., has secured permission to construct a power dam and hydroelectric generating station at Big Quinnesec Falls on Menominee River, near Iron Mountain, and will have plans completed for project at early date. Cost estimated close to $2,000,000. Mead & Hunt, State St., Madison, Wis., are consulting engineers. Plant capacity and other details will be determined at early date.

Mich., Pontiac—State Hospital Dept., Lansing, Mich., has plans for extensions and improvements in power plant at State Hospital at Pontiac, including new addition to present building and installation of equipment for increased capacity. Cost reported over $1,000,000. William C. Zimmerman, Riker Bldg., Pontiac, and Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., are architects and engineers.

Minn., Warroad—Border Counties Power Cooperative, Inc., Warroad, has plans under way for new power substation on local site. Work will be carried out in connection with line extensions in same area, entire project to cost approximately $125,000. General Engineering Corp., 2950 Chicago Ave., Minneapolis, Minn., is consulting engineer.

Mo., Booneville—State Dept. of Public Buildings, Capitol Bldg., Jefferson City, Iowa, plans new power house for central-heating service at Missouri Training School

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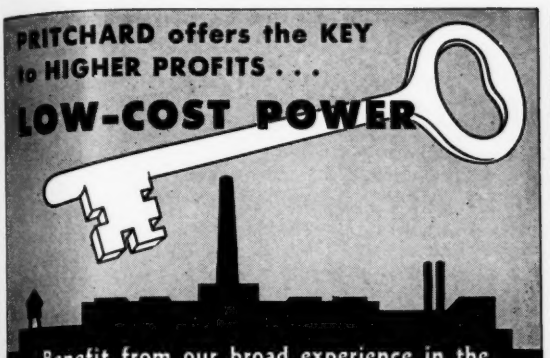

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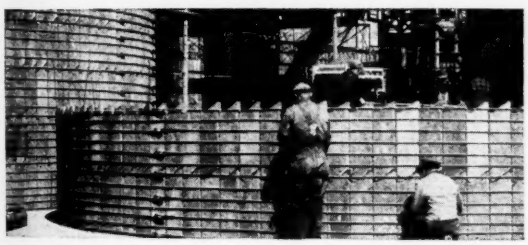

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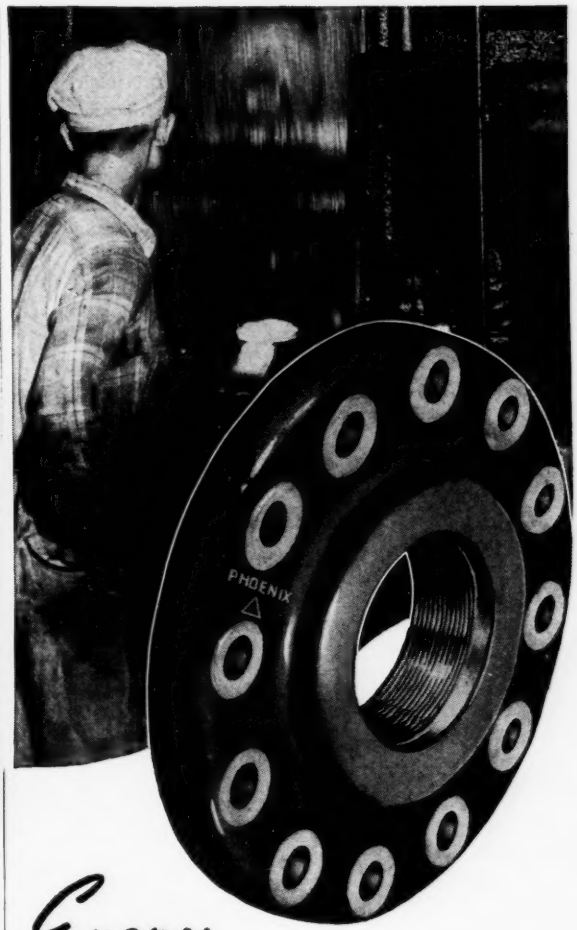

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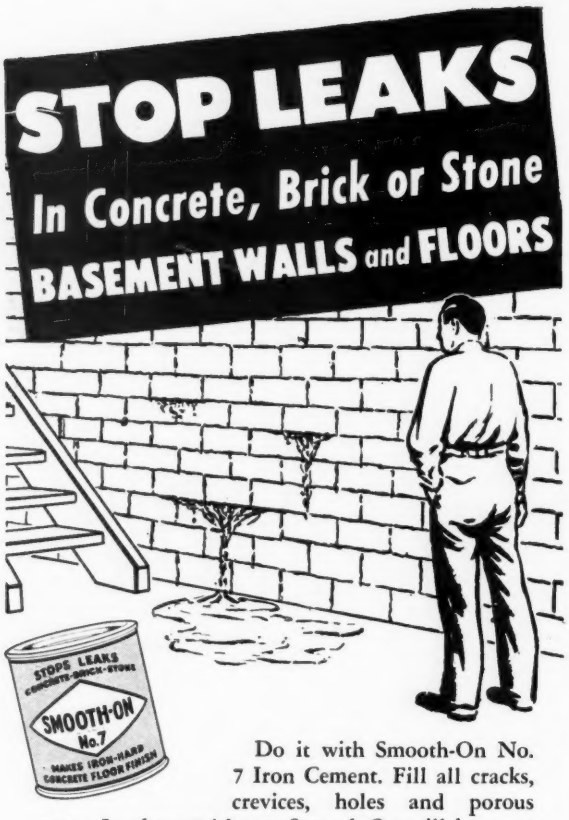

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for Boys, Booneville, reported to cost approximately $200,000, with equipment. Marshall & Brown, 114 West Tenth St., Kansas City, Mo., are architects.

Mont., Billings—Continental Oil Co., Philtower Bldg., Tulsa, Okla., plans power plant at proposed new oil refinery at Billings, where tract of about 3000 acres of land has been acquired. Project will comprise a number of large buildings, with electric power and other equipment for large output of oil and gasoline. A pumping station will be built. Battery of steel pressure tanks will be installed for storage and distribution. Entire project is reported to cost about $8,500,000. Proposed to begin work next spring.

Okla., Oklahoma City—Board of Regents, School of Medicine, University of Oklahoma, Oklahoma City, has plans in progress for new power house at institution, to be used for central-heating service. No estimate of cost announced. Leon B. Senter, Philtower Bldg., Tulsa, Okla., is architect; Collins & Gould, last noted address, are consulting engineers.

Pa., Pittsburgh—Jones & Laughlin Steel Corp., Third and Ross Sts., has plans under way for new boiler plant at Southside Works on Carson St., estimated to cost about $4,000,000, with equipment. Rust Engineering Co., Clark Bldg., Pittsburgh, is engineer and will supervise construction.

Pa., Seward—Pennslyvania Electric Co., Johnstown, Pa., plans expansion in steam-electric generating station at Seward, including installation of a new 40,000-kw turbine-generator and auxiliary equipment, and 300,000-lb high-pressure boiler and accessories. Work will be carried out over period of number of months and will cost in excess of $5,000,000. At later date, another boiler of similar rating will be installed. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

Pa., Sunbury—Pennsylvania Power & Light Co., Allentown, Pa., has plans maturing for new steam-electric generating station at Sunbury, initially projected a number of months ago, and proposes to begin work in near future. Cost reported over $15,000,000, with power substations, transmission lines and other operating facilities. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Texas, Coleman—Water & Light Dept., City Hall, plans extensions and modernization of additional equipment for increased capacity. Bond issue of $300,000 has been approved for project. Proposed to carry out work soon.

Texas, San Antonio—City Public Service Board, 201 North St. Mary's St., plans three new power substations in different parts of city in connection with expansion and improvement program in municipal power facilities. Each station is reported to cost in excess of $200,000, with transformers, switchgear and auxiliary equipment.

Va., Danville—Water, Gas & Electric Dept., plans extensions and improvements in municipal steam-electric generating station, with installation of additional equipment for increased capacity. Also will make additions to municipal electric distribution system. Entire project is estimated to cost about $1,500,000. Proposed to arrange bond issue in that amount.

Va., Norfolk—Swift & Co., Inc., Union Stock Yards, Chicago, Ill., meat packers, plans boiler house at new abattoir and packing plant on Ballentine Blvd., Norfolk, where site has been acquired. Project will comprise several one- and multi-story buildings, and is reported to cost about $660,000, with machinery.

Wis., Chetek—Wisconsin Hydro Electric Co., Amery, Wis., plans new Diesel engine-generating station for service at Chetek, to be operated in conjunction with hydroelectric power station at that place. Proposed to begin work at early date. No estimate of cost announced.

Wis., Ladysmith—Lake Superior District Power Co., Ashland, Wis., plans new power dam and hydroelectric power plant on Flambeau River, near Ladysmith. Details of plant capacity and dam construction now being determined. Application for permission to proceed with project has been made to Wisconsin Public Service Commission.

Wis., Menasha—Dept. of Electric & Water Utilities, 800 Broad St., has plans in progress for expansion in municipal power plant, with installation of additional equipment for increased capacity. No estimate of cost announced. Proposed to ask bids for addition to station early next year. Laramore & Douglass, Inc., 327 South LaSalle St., Chicago, Ill., are consulting engineers.